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The Astronomical Register.

No. 145. JANUARY. 1875.

ROYAL ASTRONOMICAL SOCIETY.

Session 1874—75.

Second Meeting after the Long Vacation, December 11th, 1874.

Professor Adams, F.R.S., *President*, in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

The minutes of the last meeting were read and confirmed.

Mr. Ranyard reported that 43 presents had been received by the Society since the November meeting. The thanks of the Society were formally voted to the donors.

The following candidates for the Fellowship of the Society were ballotted for and duly elected:

John Fletcher Moulton, Esq., M.A., of Christ's College, Cambridge.

H. J. Gibson, Esq., Junior St. James's Club, St. James's Street, S.W.

Capt. George Richard Stevens, F.R.G.S., 12, Abingdon Villas, Kensington, W.

The President in commencing said: I am sure I should not be doing justice to the feelings of the meeting any more than to my own, if, before proceeding with the business, I did not refer, in a few words, to the loss which the Society has sustained through the death of our assistant-secretary. Many of us know for how a long period Mr. Williams has faithfully served this Society—I think for about 28 years. We all know how courteous he was to the members of the Society in their intercourse with him (hear, hear). We cannot help doubly regretting his death, so soon after his dear wife: no doubt her death really caused his. At our last meeting the death of Mrs. Williams had only just occurred, and from what I heard then, I was fearful what the result might be to

Mr. Williams, and now he has followed her very rapidly. We can only express our regret. The Council has already, at its meeting to-day, taken the opportunity of offering its condolences to the family which Mr. Williams has left behind him. (Hear, hear.)

The President: I wish also to direct the attention of the Society to a letter, from which it appears that in declaring the list of defaulters at the June meeting, we named one gentleman who was not a defaulter at all, for in reality he died four years ago. I have a letter to one of the secretaries from a friend of his, who says: "I was grieved to hear, at the last meeting of the Society, the name of an old friend and brother officer, Lieut. Carpendale, read out as a defaulter. My poor friend died at Bombay, on the 16th of July, 1870, and I think it is due to his memory to make this communication, in order that the Society may do him the justice of withdrawing the sentence of expulsion."

The President: I believe the Astronomer-Royal will be kind enough to give us an oral communication with respect to the news already received from the expeditions engaged in observing the transit of Venus. At our last meeting we had the pleasure of hearing him give accounts of the expeditions so far as they had been heard from, but now he will be able to report some actual results, which I have no doubt you will be extremely interested to hear. (Hear, hear.)

The Astronomer-Royal: Perhaps I may, without impropriety, before entering on my subject, say that I am one of the members of your Society who have known for the longest time our late assistant-secretary, Mr. Williams, and I bear testimony to his affectionate interest in the Society on all occasions, and agree that we have sustained a great loss. (Hear, hear.) I will now proceed to my proper subject. On the night before last, telegrams poured in upon me with such rapidity that it was impossible to send them to newspapers in any fulness. I have them here in the state in which they reached me, and they contain some details which, I think, it will be interesting to the members of the Society to hear. (Hear, hear.) First of all I may say that much of this interesting telegraphic information came through Reuter's, and we are much obliged to that great telegraphic institution, which, so far, has sent us nine-tenths of the news we have received. First of all is one from Constantinople, which says dark and rainy weather has rendered any observation of the transit of Venus impossible at this place. That is not of great interest, and it is not the first which reached me, but as I propose to take them in longitudinal order, I give it priority. The second is from Capt. Orde-Browne, R.A., Mokattim (heights above Cairo), Dec. 9: —" The egress of Venus was observed at Mokattim this morning.

There has been much bad weather and anxiety. All well now. Contact seen through very slight haze with Lee equatorial, at about 13h. 22m. 25s. sidereal time, and with De La Rue equatorial 13h. 22m. 21s." Upon that Capt. Orde-Browne makes the remark, "Observe in the Greenwich book of observations with the model, my egress is always after other observers, except Mr. Gill's." Here at once breaks out a personal equation, which will enter into the interpretation of all observations which follow; this personal equation has been deduced by Captain Browne from his observations of the Greenwich model. "Clouds spoilt much double-image work, but many limbs and cusps were taken. The phases closely resemble those of the model," (and here I break off for the purpose of saying how much we have gained by having a model set up to imitate everything as closely as we possibly could, so that our observers have seen every portion with no astonishment at all, and with great coolness.) "The phases closely resemble those of the model, except a line of light round the planet's edge, which appeared with strong sun just after the contact. It perplexed me, and made me lose my best micrometrical measures of cusps. When I found that it continued two minutes, and that it would do so indefinitely, I turned to cusps. I have exchanged bad telegraph signals twice with Thebes, and good ones three times with Suez. Mokattim co-latitude 59° 58′ 14″." Mr. Hunter, from Suez, says: "Sky cleared partly a few minutes before contact. Contact satisfactorily observed, and a considerable number of micrometer measures were made."

Captain Abney, R.E., says from Thebes: "Beautiful morning. Sun rather shaky at first. Nice and sharp at time of contact, and good observations, though differing slightly in time. Sun pictures good. The fifty photographs in Janssen's slide include internal contact, external contact not taken. No black drop apparent in photographs after careful examination." I am happy to give his precise words, "Sun rather shaky at first, but nice and sharp at time of contact," because they represent what observers know well. I do not quite understand the phrase, "Good observations, though differing slightly in time," but here is a sentence of great importance, "Fifty photographs in Janssen's slide include internal contact." This shows that attention has been paid to a precept which I particularly inculcated upon observers, who were to use the Janssen instrument, namely, that they were to judge as well as they could when the actual contact of the limbs would take place within twenty or thirty seconds, and then set the Janssen to work. If they had set it to work too soon the revolution would have been exhausted before the phenomenon came, and if they set it to work too late the phenomenon would have been

lost by delay. But the telegram proves that by attention to my precept, and by being accustomed to the approach of Venus in our model, Captain Abney, who is a cool observer, was able to fix precisely on the time when he might expect the actual contact within the 50s. in which the Janssen would be turning round, and he secured it. I am entitled from this circumstance to attach great importance in the first place to the coolness and care of Capt. Abney, and in the next place to the advantage which has been gained by the preliminary use of the model, (Hear, hear.) I may mention here that the model is not my invention. I first heard of its use on the continent, I think, and I made one and adapted it to my own circumstances with all speed. I think that possibly in form it may be the best that has been made, and upon that our observers have been drilled incessantly, and before they went they all petitioned that each might have a model for himself, so that there are actually five British models beside the one I have at home, and all have been useful in their way. The remark of Capt. Abney, "no black drop apparent after careful observation," is very important. It so happened that in the telegram the word is "carnal" examination (laughter), but there can be no doubt "careful" is the word. It is important because photographs are things which have no nerves, and they put out of the question the possibility of nervous influence, and leave the photograph open to everything optical. Although this record is imperfect from want of details, it is very important from the fulness of the characteristic observations.

I have here a telegram from Mr. John Burns, of Glasgow, who, if I mistake not, is one of the principal directors of the great Cunard line of ships. The report, which is from Alexandria, however, is incomplete in several respects, because, although the times are mentioned, it gives no authority for the times, and therefore I cannot say that it possesses the same value as the others, except for one remark. Its says, "The ingress commenced at such a time, and the final egress was between 8h. 33m. and 8h. 34m. 46s. Clouds covered the sun and prevented ascertaining the precise exit." But the part I wish to call attention to is this: "The planet looked like a black ball, with red under lower circumference." Now, I wish to call attention to the fact that the man who saw that, saw it well, for he saw the atmospheric dispersion on the edge of the planet Venus, and he is an accurate man. I wish we could have the other parts of the observation from him accurately, but at present the reference to time is inadequate. I cannot say, with the exception of that particular point, that the observations are of much value, though possibly they may be made more valuable in time, but I wish I had such a man as

that for an observer. The next telegram proceeding easterly comes by Reuter from Bushire. "The transit was beautifully observed." It does not say by whom, and that is a misfortune attending most of Reuter's telegrams; though we shall hear more about them in time, no doubt. "The interval from the commencement to the end of the apparent contact, 4h. 37m. 32s.; the interval between the two internal contacts, 3h. 42m. 56s." And then comes the remark, which is worth notice, "No black drop appeared." Proceeding in the same direction, next comes a telegram in regard to Colonel Tennant's observations at Roorkee. This telegram came several hours before any other, and it will gratify Mr. De la Rue to know that his second box of chemicals arrived in time. It says, "Observations here were successful, 100 photographs were taken."

This last telegram has, I believe, been published, but I give it with the others.

Another Reuter's telegram from Calcutta says that the observations there were excellent. Mean time ingress centre was 7.56 a.m.; middle, 10.5 a.m.; egress centre, 12.13 p.m. This labours, however, under the same misfortune of the references to time being inadequate. From Madras a telegram, through the same agency, mentions that satisfactory observations were almost impossible, the endeavours being frustrated by cloudy weather. From Kurachee Reuter's agency learns that the first external contact happened before sunrise, at 10m. 26s. past six. It is clear that if the first external contact took place before sunrise, the sender of the telegram could not have observed it, and must have taken the time from a book, and therefore we may pass over his other times.

From Shanghai—A telegram, through Reuter's agency, says that during the period of the transit of Venus the weather at Shanghai was overcast and the sun obscured.

At Nagasaki, the same morning, the "weather was magnificent; the transit observations in Japan were most successful. Observations of the contacts were made by revolving photographs." That is what we call Janssen's plan, and I suppose this report, though no name is sent, comes from Janssen himself, who, I believe, is at that station. "Fine telescopic images. No ligament. Venus seen over sun's corona." That is a singular report, which we have not from any other station. It is what, in our language, we should call over the chromosphere, but I cannot say how much is included in the word corona. "Glass photographs and silver plates." I call attention to this because the expression is rather obscure, and the language may not be familiar to many of the younger fellows of the Society. Glass photographs are

common; but silver plates are only known to those who remember the reign of daguerreotypes, and it is apparently to them that reference is made, and it is important when we remember that in exactness there is no comparison between a glass photograph and a daguerreotype, the latter being infinitely more accurate. The telegram continues: "Cloudy at intervals; two members of our mission have made observations successfully at Robe." I cannot say what this means; it is one of the difficulties in which telegrams frequently leave us.

From Berlin, another Reuter's telegram says, "A telegraphic report from the German expedition sent out to observe the Transit of Venus at Ispahan has been received. It states that although the weather was unfavourable, 19 serviceable photographs were secured. The observations of the contact were materially hindered by the clouds." From St. Petersburgh the news is that the conditions were favourable at several places. A telegram from Struve of Pulkowa, to which more importance is to be attached, says: "Transit of Venus full success at following places: Wladiwostock, Yokohama, Tschita, Orianda, near Jalta; partial success at Possiet, Habarowka,; completely cloudy at Blagoweschtschensk, Omsk, Orenburg, Uralsk, Kazan, Astrachan, Kertch, Tiflis, Eriwan, Naktritchevan. From fifteen stations reports are still outstanding." This is rather a black report, but the number of stations is enormous, and to secure a good nnmber of them will do very well. Then another message comes from Foerster, of Berlin, "Ispahan, nineteen good photographs in very unfavourable weather." Then comes the final one by Reuter:—"Hiogo (a place in Japan)—The Transit of Venus was successfully observed here. At Adelaide observations have been partially successful. At Hobart Town the American astronomical party have had partial success in their observations.—Professor Ellery reports from the Melbourne Observatory that all the phases of the Transit of Venus have been successfully observed." I believe this is the latest authentic information which can be given; at any rate, it is the latest which has reached me (cheers).

Mr. Browning: Will you kindly state to the meeting, Sir George, whether the list of observations, so far received, have been more or less satisfactory than you anticipated?

The Astronomer Royal: It meets my expectations very fairly, for I think about one-half are successful. At the important stations I think more than one-half were successful, the failing half are principally on the Russian chain of stations, where we can spare a good many, if necessary.

Mr. Carrington: Have you heard of the arrival of the party at Kerguelen's Land?

The Astronomer Royal: No, I have not. They left the Cape of Good Hope on the 18th September, and there has been no opportunity of hearing since. The connection with Kerguelen is very long indeed; there is a month to the Cape of Good Hope, and an indefinite quantity backwards and forwards. I should like much to get information from Kerguelen's Land, from the Sandwich Islands, and New Zealand; but at any rate at one station with which we have taken a great deal of pains the observations have been completely successful, I mean the very important Egyptian station, and that at present is the only British station from which we have received information.

Lieut. Stiff said, that at Kurrachee the observer was General Addison. He had taken out an equatorial by Cooke, he believed, and had built a small observatory there. He felt sure there must be some inaccuracy as to the time in the telegram.

The Astronomer Royal: It is possible the telegram came from the gentleman you mention, but those which come through Reuter have no name.

The President: Do you know the dimensions of the aperture of the telescope?

Mr. Berthon: 12¼-inches; I supplied it to him.

The President: Perhaps, as we are on the subject of the transit of Venus, I may read a note received from Mr. Hind. He says: "December 11th, 1874. My dear Sir,—The only observed time of internal contact of Venus, pretending to any accuracy, which we have yet seen here is that published in the *Times* of yesterday, as having been observed at Alexandria. I have had the curiosity to compare this observation with the result of accurate computations. First, with Le Verrier's elements of the sun and planet, and the semi-diameters recommended by him at page 40 of the Introduction to his tables of Venus, and, secondly, with Carlini's sun and Lindenau's Venus, and the old *Nautical Almanac* values for semi-diameters. The observed time of second internal contact at Alexandria to which I have referred is, Dec. 8 at 20h. 5m. 40s., local mean time. With Le Verrier's elements, I find it, Dec. 8 at 20h. 5m. 39s. Correction to computed time + 1s. (so very small a difference is no doubt to a certain extent fortuitous.) With Carlini's and Lindenau's elements, I find it, Dec. 8 at 19h. 50m. 46s. (correction to computed time + 14m. 56s.)

"This comparison shows to how great an extent Le Verrier's theories of sun and planet have benefited us in respect to this year's transit of Venus. As you may probably be in possession to-day of observed times at one of the normal Egyptian stations, I add my results for Cairo and Thebes, deduced, with every care, from Le Verrier's tables and semi-diameters. The original calcula-

tions for Alexandria also accompany this for your satisfaction. I recently made a close examination of the transits of 1761 and 1769, after determining elements from Le Verrier's tables. As was to be expected, I arrived at very similar conclusions to those he has obtained in his work for the tables of Venus. With regard to semi-diameters, I now think it will probably be found that we should have made closer predictions of the times of contact by adopting the values to which I have alluded. As Le Verrier remarked to me 'the two must go together;' and up to the late transit, we had no means of insuring this, except by adopting the diameters deduced from the transit of last century.—I remain, my dear sir, yours very truly, J. R. Hind."

The following memorandum was also enclosed, with Le Verrier's values for semi-diameters (Introduction to tables of Venus, page 40):—

Cairo. 2nd internal contact, Dec. 8. 20h. 11m. 8s., local m. t.
2h. 5m. 1s., 4 E. 344°·7 N. to E.
+30°· 2′ 4″. 32·3 Vert to E.

Thebes (Ruins of Sincor). 2nd internal contact, Dec. 8. 20h. 16m. 0s. local m. t.
2h. 10m. 21s. 1 E. 344·°8 N. to E.
+ 25° 41′ 57″. 35·3 Vert to E.

Alexandria. 2nd internal contact, Dec. 8. 20h. 5m., 39s. l. m. t.
1h. 59m. 25s. 65 E. 344·°7 N. to E.
+31° 11′ 47″. 32·1 Vert to E.

The Astronomer Royal: I would wish only to ask one question for information as to the data given by Mr. Hind, where he speaks of the old tables of Venus; did these old tables contain the term depending on eight times the mean longitude of Venus, minus thirteen times the mean longitude of the earth, because he alludes to the circumstance of their being fourteen minutes and some seconds wrong, and when I published my investigation of the additional term needed in the theory of Venus, I pointed out that it would make a quarter of an hour's difference in the time of the transit of Venus of 1874. I should like to know whether his conclusion arises from this circumstance?

The President: I am not aware.

Mr. Brett: Mr. President, now that the disc of Venus has been seen, I believe, on the corona in broad daylight, perhaps the Fellows of the Society will not persist in denying that it is possible to see the corona in daylight, because you could not have seen the disc upon the corona without seeing the corona. About a year ago, when I ventured to say that the corona could be seen in broad daylight, this Society laughed. (Laughter).

Mr. Wilson: I may say that it is no new observation to see

something projected upon the corona. I saw the moon, during the total eclipse of 1860, after it had left the body of the sun for a space of five seconds, projected against the corona, so that the observation of Venus is only a repetition.

Mr. Ranyard: There are records of observers who have professed to see the moon for a much longer time. One, during the 1869 eclipse in America, as far as I can remember, observed it for 14 minutes after totality—that is to say, he saw the whole circumference of the moon, the limb that was off the sun, as well as the limb upon the sun, for 14 minutes after totality. The dark limb of the planet Venus has also been frequently seen when she has been within a few degrees of the sun. This has been frequently observed, not only with Venus, but also with Mercury. When the planets have been very near to their inferior conjunctiôn, the thin crescent of light has been seen to contain, as it were, a black circular disc, which could be recognised as darker than the surrounding sky. There must, therefore, be some bright background, even at 2° or 3° away from the sun, sufficiently bright to show up the opaque body of the planet.

The Astronomer-Royal: Has the planet been seen as dark upon light before?

Mr. Ranyard: Yes, very frequently, I believe.

Capt. Noble: I have seen Venus at nearly every inferior conjunction that has happened during the last 10 or 15 years, and have seen her as a dark spot upon a bright background. I once saw her within 3 or 4 hours of an inferior conjunction like a fine line of silver, and the other limb, or rather the entire disc, was sharp and black; in fact, when the atmospheric conditions are favourable, I can always see the dark limb when she is near to conjunction. I think I remember mentioning, at our old rooms at Somerset House, that on the occasion of the penultimate or anti-penultimate eclipse I traced the moon's limb distinctly on to the sky, outside the sun altogether.

Mr. Neison: I saw it quite 20″ beyond the limb.

The Astronomer-Royal then read an unfinished paper *On the Method to be used for the Reduction of the Observations of the Transit of Venus.* Pressure of time had prevented him finishing the paper, but he intended to do so, and present it complete at another meeting. In the method for the reduction of the observations of the transit of Venus which he now submitted, there was no mathematical novelty. The conditions of the series of observations might be very different from those of any observations known to him; different influences, different observatories were concerned, different instructions had been given, different

glasses had been employed, and different theoretical views had actuated astronomers who had planned the observations. He had, therefore, thought it well to call the attention of the Society to a form of reduction which should include in one group the observations made at all places and by all methods; and in this form he hoped the whole body of observations would be reduced, at least, in the first instance. It possessed this great value, amongst others, that it enabled them at once to point out faulty observations, which otherwise might lurk undiscovered, and producing a baneful effect on the calculations; but those investigators who desired to ascertain the result deducible from a limited class of observations would find this method also gave every facility. The equations to be used were ready to hand, and it was only necessary to separate them from others. Still, he hoped in the final reductions the whole mass of observations would be used in one group, and every individual observation would have an influence proportioned to its merits; and reason, as well as the formula, led him to think that the best final result would thus be obtained. Possibly there were some legal gentlemen in the room, and they would understand what he meant to do if he used a term which was to be found in Blackstone—viz., the bringing of everything into "hotch potch." In the first step they must call for the assistance of the calculators of Ephemerides, if the same tabular bases were employed throughout the world. It would not be very injurious to the result if the elements used were wrong by a second or two, but it was of the utmost importance that the same errors should be continued throughout without the slightest alteration. There were several elements to be calculated: right ascension, polar distance, sun's radius, position of centre, etc. These elements ought to be prepared for intervals throughout the entire transit every minute before the first external contact was visible from the earth's surface to an equal time after the last contact was visible from the earth. During the middle of the transit it might suffice to make these calculations for every minute of mean solar time, but near the approach of the limbs—say a minute from internal contact to a minute from external contact—the calculations ought to be made for every ten seconds of time. This is a work for which he felt he should not appeal in vain to Mr. Hind. From a systematic comparison of these calculated positions with the observations, the parallax of Venus was to be deduced. The meeting would perceive the gist of the method. They might assume the right ascension and polar distance of the sun's centre to be correct. He asked the Society to excuse his very imperfect paper. He hoped to complete it, and lay it before the Society at another meeting, but he looked upon

it as a very important matter to get a process which would include every observation of every country, so that we might take up any observation we pleased, and compare it with our own, (Hear, hear.)

The President: There can be no doubt that this is the right principle to adopt—a general method must be employed—which will include all the foreign observations.

The Rev. E. L. Berthon exhibited a new "Equestrian Equatorial." He said that he understood that the name of the telescope had given rise to some punning remarks, but he wished to say that he had not called it an Equestrian telescope because it was the particular hobby of anyone, or because it was a rider to something else (laughter), but because it rode somewhat as a man rides on a saddle, having weights on each side to keep it in position, as perhaps a bad horseman might desire to have. His object was to bring a good and useful instrument within the reach of the increasing number of amateur astronomers. By means of this mounting a great diminution of weight was secured; and vibrations were reduced to a minimum. It was so light that it might be driven by a small clock, in a box five inches by three. The aperture of the particular telescope shown was 12¼ inches. It might be thought by some that a telescope so far from its declination axis would be unsteady, but the instrument was so completely *trussed* to its supports, of which there were no less than six, that no unsteadiness could be perceived. This one was made of the lightest materials, and yet there was no vibration. He had attached to it a Newtonian "finder," and also an achromatic finder, which could be used for educational purposes, so that when a child for example was examining any celestial object he could also see it and explain it from the other side of the telescope. Mr. Webb had used one of these telescope mountings for many years. It was not pretended to be very finished. Its chief merit was its cheapness, and it did its work very well, and was as good as any reflector could be. He did not profess to "find" with it very closely, but he could always find an object with a power of 200 or 300—he would not say in the centre of the field, but quite sufficient for amateur work. The cost was 100 guineas, and from £10 to £20 more for the clock.

Professor Pritchard said he had tried this form of telescope, it was a very admirable one for an amateur who wanted one at a small cost. It was singularly steady, and quite suitable to find with. He could with his generally find what he wanted to look at—not always. It was a rough affair, but possessed most marvellous excellence. With one of the Browning mirrors of 10 or 12

inches, an amateur might see all he wished. Its cheapness was a remarkable recommendation, but they must not expect too much from it.

Mr. Berthon said he would not mention Prof. Pritchard's telescope, because it was a comparatively poor thing, and was his (Mr. Berthon's) first attempt, and was got up at a cost of £20.

Mr. Pritchard: It cost me a great deal more. (Laughter.)

Mr. Berthon said he sold it, he believed for £24 10s., including the cost of taking it over and fixing it in the observatory. He was quite ashamed of it, and it was very ricketty. (Laughter.)

Prof. Pritchard said it cost him altogether £60, and he would rather have it than this one. (Laughter.) He should be exceedingly afraid of the overhanging part of the axis, but his own was wonderfully stable. This on a larger scale would, he feared, be very shaky.

Mr. Berthon: No, indeed, it is very stable.

Mr. De la Rue said it did not appear to him the telescope would be unstable so long as the foot in front projected sufficiently in the direction of the overhanging axis, and was sufficiently strong. Moreover, he thought that it would be a good thing for astronomical science that a cheap workable instrument could be placed in the hands of amateurs. It appeared to him to possess the elements of great rigidity. With regard to "finding," if a little care were taken in adjusting the instrument, and allowance made for any deviation in the position of the wires of the finder, he saw no reason why the telescope should not be directed on a star in the daytime, and be found very well in the field. He thought astronomers were very much indebted to Mr. Berthon for placing such an instrument within the reach of amateurs.

Mr. Knobel then read a paper on an instrument which he called an "Astrometer." A model of one was exhibited at the meeting. He said that, having been engaged in determining the relative brightness of stars, he had invented this instrument to enable him to do so with greater accuracy. It consisted of an equilateral triangular aperture, which could be increased or diminished within the telescope down to zero. The instrument had been made for him by Mr. Browning, the motion was smooth and easy, and the centering of the triangle was practically perfect. To estimate the magnitude of a star with it, they must determine the area of the smallest aperture with which the star was visible. The instrument would fix readily on to a telescope tube, and was accessible to the hand of the observer. The observer, by turning a screw, could easily reduce the aperture, so as to quite extinguish the star, without moving his eye from the eyepiece. It was suggested in the last century, by Bailly, that

the brightness of each star should be determined on photometrical principles, and that in every instance the aperture should be diminished till the star ceased to be visible. In this little instrument he had endeavoured to comply with some of the practical requirements, and he trusted that those who took up the interesting subject of photometry would not find it altogether useless. He was indebted to Mr. Gray for the formula for calculating the brightness of the star from the length of the side of the triangular diaphragm, when the instrument was adapted to a Newtonian reflector, and the area of the triangle was reduced, so that the sides cut off segments from the circular area interfered with by the flat.

Mr. Gray explained his formula to the meeting.

Mr. Dunkin read a paper *On Personality in Observing Transits of the First and Second Limbs of the Sun.* He said the subject had already been noticed in the *Monthly Notices,* but it was again brought before the Society by an observation of Capt. Noble on November 13th, as to the determination of the longitude from observations of the moon, in which it was suggested there might be a residual error equal in some cases to 4s, which might be owing to the personal discordance between different observers; and although it seemed scarcely possible that so great an error could not be eliminated by the lunar method when an equal number of observations of the first and second limbs were taken, yet it happened that in the comparisons of the places deduced from the observations of the moon with the altazimuth, the amount of personality in the observations of the limbs was sufficiently great to account for the discordance between the telegraph and the lunar methods, which had been mentioned. The Astronomer-Royal has suggested that it would be interesting, and, at the same time, important, to investigate the amount of personal difference between the meridional observations of the first and second limbs of the sun, as observed at Greenwich, and treat the subject in the same manner as in the former examination of lunar limbs. Mr. Dunkin had concluded there could be no well-marked personality detected, but he found afterwards he was labouring under a wrong impression of what could have been gathered from such observations. He has now confined inquiries to the ten years between 1864 and 1873, the result being that great personality is shown with regard to both the sun and the moon, which of course affects observations for longitude. In the case of two observers at Greenwich, who had about 20 years' experience, there is a difference of 2 seconds of arc in their observation of the position of the centre of the sun and moon, therefore, when we are determining the longitude by the lunar method, one observer will refer

an observation to a very different centre to the other, simply because he has a different personal equation for the first and the second limb. It being thus well marked in the comparisons from year to year that one observer will have a different personal equation of 2 seconds of arc, or 2-15ths of a second of time, between the tabular errors deduced from the first limb and the second, continuing year after year, it becomes very important to make a correction for this personal error in determining the longitude by the moon and moon-culminating stars, or there may be a considerable number of observations with this residual error in all. Mr. Dunkin has taken the trouble to investigate these figures, and any one will see their importance in determining the longitudes of the stations from which the transit of Venus was observed. In consequence of the remark made by Capt. Noble at the last meeting, the Astronomer-Royal referred to Mr. Dunkin's former paper, and the well-marked personalities exhibited there made him anxious to see whether these same differences occurred in the observations of the limbs of the sun. The figures (which are appended) show that the personality exists entirely in some peculiar estimate of the observer.

The President: By comparing the observations of the limb with the Le Verrier's tables you can get the relative error quite independently of any other. You can get the relative error for the first limb, and then for the second limb, just as you can get relative errors for the stars. I think that this is a subject of first-rate importance, and I doubt whether the longitude obtained by moon-culminating stars at the stations will really be of much value, comparatively speaking, until this personal equation of the observers has been ascertained by observations after their return. I think it would be most important that the personal equations for observations of the two limbs shall be determined in some such way as Mr. Dunkin has described; and then I think it really probable we may arrive at a much more trustworthy longitude, which can be used in the calculations for the transit; but I doubt very much whether the longitude without that protection will be accurate enough really to be depended upon.

Mr. Dunkin: The Astronomer Royal considers the question very important, and I believe he intends to devote an instrument purposely for examining these personal equations by the observers on their return.

Mr. De la Rue: The observation of a crater in the moon or some other distinct point upon the moon, together with the limb of the moon, by different observers, would bring out very clearly a personal equation as far as regards the interval between the tangential contact of the limb with the wire, and the crossing of

a bright spot on the wire; and, moreover, I think that on the observers' return they all ought, with the same instruments, to determine the longitude of Greenwich; then very likely the longitude of the places, so corrected, would turn out to be very reliable.

Mr. Dunkin: I am not able to point out the cause of the different personal equations with the two limbs. Some observers have the impression that the transits of the first limb are not seen so easily in consequence of the glare of the light causing the wires to appear very faint as the moon approaches them; then with the second limb the wire is a darker object, so that the effect from irradiation is very different. When the bright, nearly full moon is running into the field the wires almost disappear; but when the second limb is approaching you have the dark wires beautifully shown on the face of the moon.

The following papers were taken as read:—

Hyperbolical Elements of Comet (I. 1845), by Dr. Doberck.

Ephemerides of 12 *Circumpolar Stars, suitable for the determination of Azimuth error,* by the Rev. Professor Pritchard.

Extract from a letter from Mr. Ellery to Dr. Robinson, on Nebulæ, &c.

Phenomena of Jupiter's Satellites, by J. Gledhill, Esq.

On the very much extended Nebulæ of Sir John Herschel's General Catalogue, by Cleveland Abbe.

On Professor Holden's paper on observations of the Satellites of Uranus, by Mr. Marth.

The meeting adjourned at ten o'clock till the evening of January the 8th.

TRANSIT OF VENUS.

Lord Lindsay's Expedition.—Lord Lindsay has telegraphed a report of his observation of the transit of Venus at the Mauritius. The last half, he says, was very satisfactory. Good photographs were obtained, also measures and time determination. His lordship is altogether well satisfied.

Melbourne, Dec. 29.—Intelligence from New Zealand announces that the Americian astronomer, Professor Peters, was successful in his observation of the transit of Venus. The German expedition to the Auckland Isles also achieved satisfactory results.

THE LATE MR. JOHN WILLIAMS.

We are sorry to record the death of Mr. John Williams, Assistant-secretary to the Royal Astronomical Society.

Mr. Williams was born Oct. 19th, 1797. His father was the head of a manufacturing firm of good standing in the City of

London. Mr. Williams was his only son, and was educated at the Charterhouse. As a boy he was of a quiet and studious disposition, and was a great favourite with his masters.

On the death of his father, he became a schoolmaster (he was then about 22 years of age), and soon after married. He was for many years master of the parochial schools of Spitalfields; in fact, until his appointment to the office in which he died, namely, the Assistant-secretaryship of the Royal Astronomical Society. About the year 1822 he became a member of the Mathematical Society, and a few years later was appointed Secretary. This office he held till the society was incorporated with the Royal Astronomical Society.

About this time he delivered many lectures on Electricity, Physics, Botany, and Geology, and especially one on Mental Arithmetic, which attracted much attention. He also spent much time in making casts of coins, &c., of which he had a fine collection. The great work, however, of his early life, was the study of and attempt to decipher the Egyptian hieroglyphics. Finding the copies of inscriptions hitherto in use utterly unreliable, he invented an improvement in the method of copying by mechanical means, for which he received the silver medal of the Society of Arts. His copies of the sarcophagi, tablets,and statues in the British Museum, of the Rosetta stone, and of the monuments in the Ashmolean Museum at Oxford are of the greatest value.

In these undertakings he was assisted in many ways by Dr. Lee and others, without whose aid he would never have achieved so much.

His first work, entitled " Essay on the Egyptian Hieroglyphics," was published in 1836 by subscription. His great theory was that the characters were not letters—as is generally believed—but symbols for words or ideas; and he sought to find the sound, and, from the sound, the meaning, from Coptic, Arabic, Syriac, and Hebrew, which languages he maintained to be allied to early Egyptian. This theory, however, did not meet with approval at the hands of other scientific men. From Hieroglyphics he turned his attention to Chinese, from the study of which as a "pictorial," and not an " alphabetical," language he hoped to obtain the key to his former problem. In 1871, he published his " Observations of Comets by the Chinese."

His knowledge of languages was considerable—French, Latin, Greek, Hebrew, Arabic and other eastern languages. He was eminent as an Archæologist, and a Fellow of many Scientific Societies.

He had also a thorough knowledge of mathematics and

astronomy; but there is no doubt his claim to fame rests mainly upon his wonderful knowledge of Chinese, which, though he only began to study it when he was more than 50 years of age, he succeeded in thoroughly mastering, as far as its literary and scientific portion was concerned.

His reading was most extensive, and he imparted his knowledge to the public in lectures at the London Institution, the Royal Institution, &c.

His powers of abstraction were very great, and his habits industrious; indeed, he was always either working or reading.

His connection with the Astronomical Society was a source of great pleasure to him, and he could not be persuaded to resign his post, even when he might well have done so, on the Society's removal from Somerset House. The fatigue of moving, however, and the sudden death of his wife on the 10th of November, after a union of 52 years, brought on symptons of heart disease, and he sank, after much suffering, on the 3rd of December, 1874, in the 78th year of his age. He was buried with his wife at Highgate Cemetery.

At the last meeting of the Society, many members regretted that no deputation from the Society attended his funeral.

REVIEWS.

Brinkley's Astronomy. Revised and partly re-written, with additional chapters by John William Stubbs, D.D., Fellow and Tutor of Trinity College, and Francis Brunnow, Ph. D., late Astronomer-Royal of Ireland, and Professor of Astronomy in the University of Dublin. Second edition, enlarged and improved. Longmans. London, 1874. Price 6s.

The preface states that this book has been used as a text-book in the University of Dublin for more than 60 years. It has now been endeavoured to bring it up to the present more advanced state of the science. As far as we are able to judge after reading, though not studying, the whole, its editors have accomplished their revision well, and made the volume a desirable acquisition to the student, who soon discovers that the more treatises on the science he can procure the better. He finds in one either something which others omit, or handle with less plainness or fulness. A large mass of information will be found in this work, and generally well expressed. We think many of our numerous amateur astronomers will be glad to possess it. We have noticed a few blemishes and errata in going through the book. Proper names are sometimes mis-spelled—p. 46, Bougier for Bouguer; p. 21, Couchoix for Cauchoix; Fourcault for Foucault, pp. 63, 152, 186, 322, 324; Maskeline for Maskelyne, pp. 209 (bis), 323; Procter for Proctor, p. 324. The number of the minor planets is given only to 1871, p. 3. [We observe, by the way, that the *Nautical Almanack* for 1875 drops the usual list of these little planets. It will be difficult soon to get a complete list to a recent date.] Alcon does not impart sharpsightedness in Arabic, as stated p. 26. See Smyth's *Cycle* 2, p. 300, and Appendix to *Astronomical Register*, 1871. It is a corrupt word. Page 34, "half the sum or the difference," either "or the difference" should

be omitted, or something more supplied. Page 57, the solar photographs at the Kew Observatory we believe are not now continued. Page 62, "from east to west" should be from west to east. Page 110, the concluding part of the note is not plain. Should it be, "does *not* hold good," &c.? Lastly, page 151, Mr. Stowe's re-discussion of the observations of the transit of Venus in 1769 and his conclusion, should have been mentioned. See *Astronomical Register*, 1868, p. 219, &c., and 1869, p. 61, &c.

Transits of Venus. A popular account of past and coming Transits, from the first observed by Horrocks, A.D. 1639, *to the Transit* A.D. 2012. By Richard A Proctor, B.A., Camb. Longmans, 1874. [Price 8s. 6d.]

"This work," says the author, "is intended to be partly historical and partly explanatory. So far as I know, no book has hitherto been published in England giving a complete account of the transits of 1639, 1761, and 1769, and of the various interesting circumstances connected with them. This want I have endeavoured here to meet, illustrating by maps the conditions under which those transits were observed. In the chapters relating to the transits of 1761 and 1769, I sketch the causes of the partial failure of the observations then made, and give an account of the attempts made in recent years to reconcile those observations with the present estimate of the sun's distance. It will be observed that in dealing with the latest of these attempts, I adopt the opinion of Continental and American astronomers, no longer regarding that attempt as in any sense removing the difficulties recognised before it was made." * * *

The plans of the various scientific nations for the transit now at hand are worthy of the occasion. Astronomers attach just value to the beautiful method of Delisle, while not losing sight of the favourable opportunity presented for applying the simple method invented by Halley. They have wisely noted the fact that all the best Halleyan Stations are excellent also for Delisle's method, and have taken such measures that, if bad weather should prevent the beginning or end from being both observed, one or other may still be utilised. In this way new Delislean Stations have been obtained by the very arrangements which provided for the employment of Halley's method; and thus the chance of absolute failure through bad weather has been very largely diminished. The long-neglected region in North India has been occupied, and useful observations will doubtless be made there. Southern observing stations are also now amply provided for—first-class Halleyan Stations having been quadrupled in number since last year, when it was pointed out that the want of them endangered the whole scheme of operations.

This work probably contains a greater amount of accurate information on the subject treated than any other volume in the English language. As in all the productions of this indefatigable author, the excellence of the plates, coloured and uncoloured, and the woodcuts, is remarkable. Amongst other tables, one (VI.), giving the sun's mean distance in miles to each hundredth of a second of parallax from 8′ to 10′, is very convenient. Chapter IV., on transits and their conditions, is perhaps as little difficult as the intricacy of the subject admits of its being made to the general reader. The chapter on the coming transits, with much valuable matter, reviews points which have been warmly discussed; on which—however we may have formed a pretty confident opinion—we will refrain from commenting, unwilling at a time when success seems largely to have crowned the anxious and laborious efforts of so many workers, and when an immense mass of observations will have to be

discussed, which will need all the time, pains, and discrimination that the most skilful astronomers can give to them, to harp on anything of a jarring and unpleasing nature. Rather, in prospect of the feast that awaits us, let all differences be forgotten, and our satisfaction be unclouded by any incidents in the past. Mr. Proctor says, in the last sentence of his book, "Let it be hoped that the success of operations conducted by the various scientific nations in 1874 and 1882 may be such that preliminary difficulties will hereafter be remembered only as obstacles successfully removed, and in good time." And, cordially agreeing with this sentiment, we should be glad in a future edition to find the personal element (on all sides) absent, and in place of these preliminary difficulties, to have an abstract—such as the talented author is so competent to give us—of the work at the different stations, though it might yet be too soon to look for the grand conclusion from the whole.

The Transit of Venus. By George Forbes, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. Macmillan and Co., 1874. [Price 3s. 6d.]

This little work, though not covering the same ground as the preceding, nor nearly so exhaustive where its scope is the same, is an acceptable endeavour to explain the elements of the subject to the ordinary reader. In the preface, dated June, 1874, Professor Forbes says:—"The account of the preparations of the different nations is as complete as it was in my power to make it." There are many illustrations, and drawings of the instruments employed in the British expeditions. It will be remembered that the author himself belongs to the expedition to the Sandwich Islands. His work (revised from a series of articles published in *Nature*) will be useful even to those who possess Mr. Proctor's much more elaborate volume, and certainly welcome to such as cannot afford to procure that work.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

PHOTOGRAPHY AND THE TRANSIT OF VENUS.

Sir,—In one of the excellent articles in the *Times* on the Transit of Venus (Dec. 11) there are one or two mistakes which it may be worth while to correct. The writer says, speaking of the photographs, "we have a double series—photographs on silver, and photographs on daguerreotype plates." The sentence should read, "photographs on silver (daguerreotype) and photographs on glass." The writer also says, speaking of daguerreotypes, "though they cannot be copied conveniently." As a matter of fact, no kind of photograph is so easily copied as a daguerreotype—it is merely necessary to place the plate so that the light falls in the direction opposite to that in which it has been polished, in other words to reverse it. It is to be hoped that all photographs, including daguerreotypes that are to be measured, have been taken of the full size required, as it is very improbable that any kind of enlarged *copy* will be of service.

Yours, &c.,

Manchester: 21st Dec., 1874. A. BROTHERS.

AURORÆ, &c., OBSERVED IN 1874.

Sir,—Perhaps the subjoined list of atmospheric and other phenomena observed here this year will possess some interest for a section of your readers.

The halos were chiefly solar. The auroræ have been mostly before midnight. The zodiacal light was observed soon after sunset in March, and before sunrise in September, October, and November. I looked in vain for it on fine evenings in November and December.

I am, sir, yours very truly,
JOSEPH GLEDHILL, F.R.A.S., &c.

Mr. Edward Crossley's Observatory,
Halifax: Dec. 15, 1874.

1874.	Halos.	Auroræ.	Lunar Bows.	Zod. Light.
January	1	4	1	
February	2	3	...	
March	6	...	...	4
April	13			
May	7	2		
June	13	6		
July	3	2		
August	1			
September	2	...	1	2*
October	...	2	...	6†
November	5	...	...	3‡
December	...			

May 1st parhelia were seen.
*On the 14th and 17th.
†On the 8th, 18th, 19th, 20th, 22nd and 23rd.
‡On the 6th, 10th and 12th.

ZODIACAL LIGHT.

Sir, - It may interest some of your readers to hear that twice this month, (on the 6th and 7th) at about 6.30, I observed the zodiacal light quite distinctly passing over Saturn, and through Aquarius.

I never saw it so early in the year before, but I should think that it is by no means difficult to observe if it is only looked for.

I might also state that since the beginning of the month I have seen forty-three meteors, from various radiant points, but on the 5th, A Arietis seemed the principal one, changing to A Tauri on the 6th; on the 7th, however, when I saw nineteen, there did not seem to be any marked radiant.

Yours truly,
HENRY CORDER.

Writtle, near Chelmsford:
Dec. 10, 1874.

STAR MAGNITUDES.

Sir,—The following stars may, I think, be suspected of being variable: In the triangle formed by o, 44, and β Aquarii, and forming roughly a square with o and 30 Aquarii. Harding in his large Atlas Cœlestis (published in 1822), shows two 5th magnitude stars. These are now quite invisible to the naked eye, and of about magnitude 6½, or perhaps 7.

I have found the star magnitudes given by Harding to be remarkably

correct, and therefore think it probable that the two stars above alluded to have faded since 1822.

The following stars also may possibly be variables:

1. A little east of α Cassiopeæ, Mr. Proctor, in his large atlas, shows a 5th magnitude star. It is now about magnitude $6\frac{1}{2}$ or 7, and fainter than a star between o and π, not shown by Proctor.
2. ψ Cassiopeæ (4m.) is now about magnitude $5\frac{1}{2}$.
3. A little west of ζ Andromedæ is shown another 5th magnitude star, which is now fainter than 36 or 28, or about magnitude $6\frac{1}{2}$.
4. Close to and north of μ Persei (between α Persii and Capella) is shown a 6th magnitude star; this is now of the 8th magnitude!
5. About 2° south of α Camelopardi, Mr. Proctor shows two 6th magnitude stars. The most northern of these is now invisible to the naked eye, nor is there any star of even 8th magnitude in its place. Will some of your readers say whether any of the above discrepancies are due merely to errors in mapping? Your obedient servant,

J. E. GORE.

THE PLANET MARS.

Recently, when at Brussels and visiting the Brussels Observatory, M. Ernest Quetelet (the son of the late director and successor to his father in the directorate) was kind enough to give me a copy of an abstract which he had prepared, of a recent paper on Mars, written by a Belgian astronomer, M. Terby. This abstract struck me as being so full of interesting points, that I thought the readers of the *Astronomical Register* would like to have the opportunity of perusing a translation of it. Being too much occupied with mundane matters to make a translation myself, I secured the services of a friend, Miss Isabella Hood, of East Bourne, who has performed her task with much fidelity.

East Bourne: Nov. 9, 1874. G. F. CHAMBERS.

In the preface to his memoir, M. Terby reviews the works of those astronomers whose attention has been specially directed to the study of the spots on Mars, beginning with Fontana, who gave the first description of this planet in the year 1636.

The principal object of the memoir is to compare the diagrams made by different observers at different periods of time; it is divided into six chapters, each of which treats of a particular region of the planet.

Chapter I.—The sea of Kaiser and the ocean of Dawes.
„ II.—The strait of John Herschel.
„ III.—The ocean of De la Rue and the seas of Dawes and Lockyer.
„ IV.—The seas of Hook and Maraldi.
„ V.—The seas of Tycho and Delambre.
„ VI.—The seas of Beer and Airy.

Proctor's map of Mars has served the author as a basis for his nomenclature. A careful and comparative study of the different diagrams, led M. Terby to conclude that some shores of the Martial seas have a clear and distinct outline, whilst others present the appearance of irregularities which should, at the next oppositions of the planet, occupy the attention of all astronomers who devote themselves to this branch of observation. As the memoir is chiefly interesting on account of its appeal to observers for the elucidation of obscure and contested points, I have taken advantage of the rapid publication and extended circulation of the *Bulletins*, to bring before public notice the questions which terminate each chapter of the work.

CHAPTER I.

1. Do the seas of Zöllner and Lambert communicate with the sea of Phillips? Are they divided into several branches?

2. Does there not exist, between the sea of Phillips and the southern limit of the ocean of Dawes, another sea parallel to that of Phillips?

3. What is the exact extent of Cassini's land?

4. Does the sea of Main consist of one or several lobes?

5. Is the strait of Nasmyth subject to tidal motion, and does it extend into the continent of Dawes? Does it terminate sharply at the East* or is it in communication with the sea of Tycho?

6. What is the configuration of the shores of the sea of Kaiser and the ocean of Dawes?

7. Does a breach of continuity exist in this great spot? notably:—(*a*) between the sea of Kaiser and the ocean of Dawes; (*b*) between the ocean of Dawes and the strait of John Herschel; (*c*) between the ocean of Dawes and the sea of Hook?

8. Which are the darkest regions that have been observed in this spot on Mars? Are these regions permanent in shape?

CHAPTER II.

1. Does there exist a breach of continuity in the strait of John Herschel, to confirm the existence of the apparent one between the bays of Dawes and of Beer?

2. Does this strait communicate with the ocean of Dawes?

3. What is the exact form of the region situated immediately to the south of this strait? The existence, the form, and the extent of the straits of Arago and Newton, and of the islands of Phillips and Jacob need to be determined.

4. The configuration of the bays of Dawes and Beer, and of the strait of Dawes should be further studied, also their direction, which is so variable in the different diagrams.

5. Confirm the existence of a cape or peninsula at the west of the bay of Dawes, which protrudes into the strait of Herschel.

6. Does a bay, which is yet unknown, exist between the sea of Kaiser and the forked bay of Dawes?

7. The different shades which these regions present, and the penumbra which Lockyer, Kaiser, and others have observed, should be carefully observed.

CHAPTER III.

1. Does the ocean of De la Rue possess on its northern shore an angular or rounded contour?

2. Fix the southern limit of the ocean De la Rue, and establish its relations with the polar sea of Phillips and with the sea of Maraldi.

3. Study the connexion of the ocean De la Rue with the straits of Arago, Newton, and John Herschel.

4. Find the breaches of continuity which are thought by some observers to exist in the ocean De la Rue.

5. Find the snowy spot of Dawes.

6. Study the darker portions observable in the ocean De la Rue.

7. Is the fact of the communication of the seas of Dawes and Lockyer with the ocean De la Rue indisputable?

8. What is the true outline of the seas of Dawes and of Lockyer?

9. Does any communication exist between the sea of Dawes and that of Maraldi?

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* These indications presume the observer to have the disc of the planet *before* him.

CHAPTER IV.

1. What is the exact extent of the sea of Hook relative to that of Maraldi?

2. Does a dark tract exist between the seas of Hook and Maraldi, and that of Phillips?

3. Verify the existence of Webb's land.*

4. Examine the situation of the darkest regions which might exist in the seas of Hook and Maraldi.

5. Define the exact configuration of the northern shores of the seas of Maraldi and Hook, and of the bays which it presents, also the passes of Huggins and Bessel.

6. What is the precise configuration of the sea of Huygens?

7. Find the small white spot that Webb and Gledhill have observed near the pass of Huggins.

8. Define with greater accuracy the vague spots in the continent of John Herschel, at the west of the sea of Kaiser.

CHAPTER V.

1. What is the exact form of the seas of Tycho and Delambre? Does it agree with that given by Proctor, or with those obtained by the observations of 1871-3? In other words, is the land of Rosse a permanent isthmus or was this tract due to a passing cloud at the time of the observation made by Dawes?

2. What connexion is there between this spot of Mars and the sea of Beer and the strait of Nasmyth?

3. Study the configuration of the two dark bands which connect the sea of Tycho and that of Delambre with the more western regions, and examine whether they are not in reality prolongations of these two seas combined only at the east?

4. What is the form of the dim tract from the sea of Tycho to the west, and what is its connection with the sea of Airy?

5. Verify the existence of a breach of continuity between the sea of Tycho and this dim tract.

6. Confirm the existence of the seas of Lassell and of Leverrier, which are only noticed in the diagrams of Dawes.

7. Study the configuration of the polar sea of Schröter.

8. Discover the white appearance which Knobel and Green have observed immediately to the right of the sea of Tycho.

CHAPTER VI.

At the close of this chapter, the author calls the special attention of observers to that portion of the surface of Mars which is least known (the passes of Oudemans and Bessel, &c.) in order that future discoveries may shed more light on its configuration.

In short, the memoir of M. Terby is a work of interest, and I have the honour to propose its publication in the collection of memoirs.

The meeting viewing with approbation the general character of the work immediately decided on its publication.

* The author proposes to give this name to a breach of continuity in the sea of Maraldi, which is not found in Proctor's map.

Errata.—Page 297, lines fourteen and fifteen from top, for *The erection of* read *The evection by.* Page 298, line sixteen, for *Preferred* read *Deferred.*

BOOKS RECEIVED.—Fraser and Dewar's "Origin of Creation." Longmans and Co.: 1874.—Science Primer. Lockyer's Astronomy: McMillan and Co.: 1874.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Aldebaran.
Fri	1	2 12	Conjunction of Venus and B.A.C. 5579 0° 9′ S. Conjunction of Moon and Mars, 2° 32′ N. Saturn's Ring: Major axis=35″·00 Minor axis=10″·01	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	15 2 16 13 17 16 18 26	— 9 44·2
Sat	2	20	Conjunction of Mars and λ Virginis (8·5m.) W. Sidereal Time at Mean Noon, 18h. 46m. 51·62s.	3rd Oc. D. 1st Oc. R. 3rd Oc. R.	14 22 15 45 16 37	9 40·3
Sun	3		Sun's Meridian Passage 4m. 41·35s. after Mean Noon	2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	15 52 18 14 18 25	9 36·4
Mon	4	9	Conjunction of Moon and Venus, 8° 39′ N.			9 32·4
Tues	5			2nd Oc. R.	15 0	9 28·5
Wed	6	10 18	Conjunction of Saturn and θ Capricorni (5·0m.) W. Conjunction of Moon and Mercury, 3° 21′ N.			9 24·6
Thur	7	5 8	● New Moon	1st Ec. D.	19 48 40	9 20·6
Fri	8			1st Sh. I. 1st Tr. I. 1st Sh. E.	16 55 18 8 19 9	9 16·7
Sat	9	3	Conjunction of Moon and Saturn, 3° 58′ N.	3rd Ec. R. 1st Oc. R. 3rd Oc. D.	15 50 19 17 40 18 29	9 12·8
Sun	10			1st Sh. E. 1st Tr. E. 1st Sh. I.	13 37 14 49 18 27	9 8·8
Mon	11					9 4·9
Tues	12			2nd Oc. R.	17 37	Moon. 4 13·2
Wed	13	3	Venus at greatest brilliancy			4 59·7
Thur	14	9 22	☽ Moon's First Quarter Illuminated portion of disc of Venus=0·273 Illuminated portion of disc of Mars=0·912			5 47·2
Fri	15	1	Superior conjunction of Mercury and the Sun	1st Sh. I.	18 48	6 37·1
Sat	16	6 51 8 4 7 58 9 11 8 51 10 0	Occultation of B.A.C. 1032 (6½) Reappearance of ditto Occultation of τ^2 Arietis (5½) Reappearance of ditto Occult. of 65 Arietis (6) Reappearance of ditto	1st Ec. D. 3rd Ec. D. 1st Oc. R. 3rd Ec. R.	16 10 14 17 29 26 19 35 19 46 39	7 30·5

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
Sun	17		Sidereal Time at Mean Noon, 19h. 46m. 0·00s.	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 17 14 31 15 30 16 43	Moon. — 8 28·1
Mon	18		Sun's Meridian Passage 10m. 39·48s. after Mean Noon	1st Oc. R.	14 3	9 29·3
Tues	19	3 18	Conjunction of Mars and ν^1 Libræ (1·4m.) E. Conjunction of Mars and ν^1 Libræ 0° 6′ N.	2nd Ec. D.	15 16 37	10 32·3
Wed	20	12 38 13 42	Occultation of *c* Geminorum (6) Reappearance of ditto	3rd Tr. E.	14 23	12 33·9
Thur	21	5 40	○ Full Moon Saturn's Ring: Major axis=34″·59 Minor axis=9″·37	2nd Tr. I. 2nd Sh. E. 2nd Tr. E. 1st Ec. D.	12 48 12 51 15 16 23 35 15	12 31·8
Fri	22					Aldebaran. 8 21·6
Sat	23			1st Ec. D.	18 3 31	8 17·7
Sun	24			3st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	15 9 16 24 17 23 18 36	8 13·8
Mon	25			1st Ec. D. 1st Oc. R.	12 31 51 15 56	8 9·8
Tues	26	21	Conjunction of Saturn	1st Tr. E. 2nd Ec. D.	13 4 17 50 4	8 5·9
Wed	27			3rd Sh. E. 3rd Tr. I. 3rd Tr. E.	13 35 16 15 18 16	8 1·9
Thur	28	10	Conjunction of Moon and Jupiter, 2° 32′ N.	2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	12 54 15 22 15 26 17 49	7 58·0
Fri	29	0 33	☾ Moon's Last Quarter			7 54·1
Sat	30	7 16 42 17 48 16 52	Conjunction of Moon and Mars 4° 0′ N. Occultation of B.A.C. 5253 (6) Reappearance of ditto Near approach of B.A.C. 5254 (6)			7 50·2
Sun	31			1st Sh. 1. 1st Tr. I.	17 2 18 6	7 46·2
FEB. Mon	1	23	Opposition of Uranus	1st Ec. R. 1st Oc. R.	14 26 6 17 48	7 42·3

THE PLANETS FOR JANUARY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	18 17 34	S. 24 34½	4″·8	23 30·8
	9th	19 13 41	S. 24 10½	4″·6	23 55·3
	17th	20 3 36	S. 22 31½	4″·8	0 17·6
	25th	21 0 31	S. 19 5	5″·0	0 42·9
Venus ...	1st	16 34 52	S. 17 18	48″·8	21 48·4
	9th	16 44 43	S. 17 14½	42″·6	21 26·8
	17th	17 2 9	S. 17 43	37″·4	21 12·7
	25th	17 25 27	S. 18 25	33″·2	21 4·5
Mars ...	1st	14 18 35	S. 12 35½	6″·2	19 32·5
	9th	14 36 54	S. 14 7	6″·4	19 19·3
	17th	14 55 12	S. 15 32½	6″·8	19 6·1
	25th	15 13 31	S. 16 51	7″·2	18 52·9
Jupiter ...	1st	13 48 42	S. 9 52½	32″·6	19 2·7
	9th	13 52 13	S. 10 10½	33″·4	18 34·7
	17th	13 55 9	S. 10 25	34″·2	18 6·2
	25th	13 57 25	S. 10 35½	35″·0	17 37·0
Uranus ...	1st	9 8 52	N. 17 9	4″·2	14 23·6
	17th	9 6 26	N. 17 20	4″·2	13 18·2
Neptune ...	1st	1 46 39	N. 9 7½		7 2·6
	17th	1 46 41	N. 9 8½		5 59·7

Mercury is not well situated for observation, rising on the 1st less than half an hour before the sun ; the interval decreasing till the middle of the month, after which the interval increases to an hour after sun-set by the last day.

Venus may be seen two hours and three-quarters before the sun at the beginning of the month ; the interval increasing to three hours before the sun at the end of the month.

Mars rises two hours and a half after midnight at the beginning of the month, and may be seen rather earlier each successive night.

Jupiter may be seen one hour and three-quarters after midnight on the 1st ; the interval decreasing to a few minutes after midnight by the last day.

Uranus is well situated for observatio n.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat.	Angle of position of sun's axis.	
	°	°	°	°	°
Jan. 1	342·66	+13·18	—3·25	1·86	— ·49
2	355·84	·19	3·37	1·37	·48
3	9·03	13·18	—3·48	0·89	— ·49
4	22·21	·19	3·59	0·40	·49
5	35·40	·18	3·70	359·91	·49
6	48·58	·18	3·81	359·42	·49
7	61·76	·19	3·92	358·93	·48
8	74·95	·18	4·03	358·45	·49
9	88·13	·19	4·14	357·96	·48

10	101·32	13·18	—4·24	357·48	— ·48
11	114·50	·18	4·35	357·00	·48
12	127·68	·19	4·45	356·52	·48
13	140·87	·18	4·55	356·04	·47
14	154·05	·18	4·65	355·57	·48
15	167·23	·18	4·75	355·09	·47
16	180·41	·19	4·84	354·62	·47
—					
17	193·60	13·18	—4·94	354·15	— ·46
18	206·78	·18	5·03	353·79	·46
19	219·96	·18	5·13	353·23	·46
20	233·14	·19	5·22	352·77	·46
21	246·33	·18	5·30	352·31	·45
22	259·51	·18	5·39	351·86	·45
23	272·69	·18	5·48	351·41	·44
—					
24	285·87	13·19	—5·56	350·97	— ·44
25	299·06	·18	5·64	350·53	·44
26	312·24	·18	5·72	350·09	·43
27	325·42	·18	5·80	349·66	·43
28	338·60	·19	5·88	349·23	·43
29	351·79	·18	5·95	348·80	·42
30	4·97		6·02	348·38	
—					
31	18·15	13·18	—6·09	347·96	·42

Assumed daily rate of rotation 14·°20.

Assumed inclination 7·°250 } on ecliptic of 1875·0.
„ node 73· 990 }

A. M.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JANUARY, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XIX. British Association map, 45° to 50° N. latitude.

Twenty-five degrees from the moon's western limb, Mercurius (26), 15° Chevallier (407) the northern part, 3° Atlas (28), Hercules (29), Lacus Mortis (D), Burg (50) the northern part, Baily (49) the southern part, 5° eastern boundary of the Lacus Mortis, 3° Miss Mitchell (430) the southern part, Aristoteles (78) the southern part, 4° Egede, (79) 3° Wedge-shaped Valley of the Alps (80), 5° Plato (132) the southern part, Schroter's Newton, Pico (131), Teneriffe Mountains (410), Straight Range (453), 2½° La Place (134), Maupertius (136), Sinus Iridum (P) the northern part, 5° Bianchini (138), 5° Sharp (139) the northern part.

This zone contains some of the most interesting objects on the moon's surface, and affords a succession of fine studies as it becomes illuminated evening after evening. We first meet with the two splendid formations, Atlas and Hercules. Webb speaks of a very dark speck in the interior of Atlas, where he has seen some clefts with Bird's 12-inch silvered glass reflector. He directs observers to look for Atlas and Hercules 5 or 6 days after new, or 3½ days after full. These formations will amply repay the closest scrutiny. The Lacus-Mortis is also a fine formation in this zone, with the conspicuous crater Burg. We next come upon the fine pair of walled plains, Eudoxus and Aristoteles, soon followed by the Wedge-shaped Valley of the Alps, with the surrounding mountains. For a brief description of these splendid objects we cannot do better than refer the reader to the third edition of *Webb's Celestial Objects*, pp. 89, 90. For

notices of the Valley of the Alps, see *Selections from the Portfolio of the Editor of the Lunar Map and Catalogue*, first issue, Art. VI., p. 7. When the Alps are fully illuminated, the very interesting plain of Plato comes into view. (See Webb, pp. 100, 101.) Most of our readers are aware that the volumes of the *British Association Reports*, 1871, 1872, contain the greatest amount of information on this walled plain. It would contribute greatly to the advancement of selenography if other walled plains of about the same dimensions were observed as assiduously as Plato has been. South-east of Plato, the Teneriffe mountains, including Pico, come in sight, followed by the range named "Straight," and the superb Sinus Iridum, styled by Beer and Mädler " perhaps the most magnificent of all lunar landscapes."

EPHEMERIS OF WINNECKE'S COMET.

The periodical comet of Winnecke (No. III. of 1819) is due to return to perihelion about March 12th, 1875. The following ephemeris is by M. Oppolzer, of Vienna.

1875. Jan.	R.A. h. m. s.	Dec. ° ′	Light.
1	15 15 3	—8 52	0·19
3	15 22 59	9 22	
5	15 31 7	9 51	0·22
7	15 39 27	10 21	
9	15 47 59	10 50	0·25
11	15 56 44	11 18	
13	16 5 42	11 47	0·28
15	16 14 52	12 14	
17	16 24 15	12 41	0·31
19	16 33 50	13 7	
21	16 43 39	13 32	0·35
23	16 53 39	13 56	
25	17 3 52	14 18	0·40
27	17 14 17	14 39	
29	17 24 53	14 59	0·44
31	17 35 40	15 17	

TO CORRESPONDENTS.

We are obliged to postpone our List of Subscriptions and several interesting articles through want of space.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps, but the Editor will not be liable for loss in transmission to all parts of Great Britain and Ireland.

Post Office Orders for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, Hackney Collegiate School, *Clarence Road, Claptôn, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 146. FEBRUARY. 1875.

GOVERNMENT AID TO SCIENCE.

For the last four or five years the public has been treated to a succession of articles written in an energetic and easy style, on what has been termed the "endowment of research." We have been assured that if a paternal government did not take up science for us England would drop into the wake of the nations. It has been more than insinuated that scientific men would not go on in the latter part of the nineteenth century working at science for science sake; they must now be offered greater inducements, they must be paid for their labours, or they would follow the example of mechanics and strike—England would be ruined.

In one article the public has been lectured and threatened, and in the next promises of great discoveries have been held out, as the result of State interference. The sun was to be examined, and weather predictions for years hence were to be the result. Cross the hands of these astronomers with gold, and results of universal importance and world-wide interest would be forthcoming. It was asserted, and doubtless with the greatest truth, that vast fields of discovery lay open before us in the study of the physics and chemistry of the glowing whirlwinds of the sun. Such discoveries will assuredly, if we wait long enough, throw light on terrestrial chemistry, and discoveries in terrestrial chemistry will be valuable to the nation at large, therefore they argue the nation's first duty is amply to endow the study of solar physics.

Whatever may be the value of these arguments, I, sir, cannot help feeling glad that a generous public should be induced to do something for astronomy; but I am, at the same time, anxious that public money should be spent to the best advantage and that

none of it should be wasted in vague schemes. Whatever is done at the public expense ought to be done with the advice of responsible people. The Astronomical Society was incorporated by Royal Charter for the express purpose of cultivating astronomy, and I maintain that that Society, or at all events the Astronomer-Royal, as the chief astronomical officer of the Government, should first be consulted. Incredible as it may appear, public money has more than once been granted for astronomical purposes, without consultation with the Astronomical Society, or the advice of the Astronomer-Royal, and I am the more anxious to point out this impropriety as the gentlemen who have so strongly advocated the endowment of physical astronomy have for some reason shown themselves anxious to shun the advice of the Society most interested in astronomy, they proclaim that it is not the granting of more money to existing public observatories that they seek. A new observatory must be set on foot, and what they term *original research* must be endowed.

Rather more than a year ago, the Astronomical Society recommended that the Admiralty should be applied to for the necessary funds to carry on fresh observations in physical astronomy at Greenwich. The money was immediately granted, and a new physical assistant was added to the Greenwich staff. A magnificent spectroscope and ample solar photographic apparatus are already at work, but this has not satisfied the agitators. They still assert in the public prints that physical astronomy is unendowed, and that it is among the first duties of the nation to establish a physical observatory, in which the director is not to be tied down to the mere routine of daily observations, but is to be paid for the prosecution of original research, which appears to mean that he is to receive his salary for prosecuting any new line of inquiry that may strike him.

With such vague propositions as these, I, sir, think it important that national monies should not be granted, without consultation with astronomers generally.

At present the government has many advisers upon astronomical subjects. At one time it is the Royal Society, or, more strictly speaking, a Committee of the Royal Society which uses the name, and for many purposes has the influence of the whole body. At another time it is the British Association, which takes upon itself the responsibility of advising the Government upon an eclipse expedition; but it seems to me that neither of these bodies are fitted to be the astronomical advisers of the nation. In the first place, all workers in astronomy, who belong to either of these Societies, are also Fellows of the Astronomical Society, and therefore no new astronomical blood can be gained by applying

through them. Again, any observations made with public money should be easily available to all interested in astronomy; but this cannot be the case, unless the observations are reported to and published in the Transactions of the Society especially devoted to astronomy. But the chief danger of applications from Societies that are not purely astronomical lies in the fact that a man of energy can, by addressing himself to the general public through the press, induce the non-astronomical members of the body to believe that he has a grievance, and prevail upon them to lend their influence for the appointment of a committee of recommendation on some plausible astronomical project, which he would have found it difficult to get supported in a Society composed purely of astronomers. It is true that, in the working of both the Royal Society and British Association, a committee would immediately be appointed, consisting of astronomical men, to advise upon the particular subject; but the committee will not represent the views of astronomers generally, and the members who do not approve of the proposed action will find it easier to withdraw than to oppose.

I cannot point my moral better than by referring to the recent application of a committee of the Royal Society for a Government grant to observe the eclipse of April next in Siam. We are informed that neither the Astronomer-Royal nor Mr. Huggins, though their names were placed upon the Committee, have given their countenance to its proceedings, and the result has been that the Committee has decided on the advice of one of its members that the sum of £1,000 which has been obtained from the Government should be expended entirely in an attempt to register, by means of photography, the spectrum of the corona, which it appears that several astronomers, who have paid attention to the subject, consider must be ineffectual.

It would surely have been better if this application to the Government had been made through the Astronomical Society, and if all those interested in the subject had been invited to discuss and advise upon the method in which Government monies should be expended. Let us trust, however, that the discontent which has been expressed may serve as a warning, and that, should any application be made to the Government for the foundation of a separate physical observatory, the Royal Society will not lend its aid except with the advice of the legitimate adviser of the Government and the Astronomical Society.

F.R.A.S.

[We reprint the above excellent letter to our contemporary the *Athenæum,* and commend it to the consideration of our readers.]

ROYAL ASTRONOMICAL SOCIETY.

Session 1874—75.

Third Meeting after the Long Vacation, January 8th, 1875.

Professor Adams, F.R.S., *President,* in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

The minutes of the last meeting were read and confirmed.

Mr. Ranyard reported that 34 presents had been received by the Society since their last meeting. The thanks of the meeting were formally voted to the donors.

The following candidates for the Fellowship of the Society were balloted for and duly elected:

Albert Duncan Austin, Esq., C.E., Nelson, New Zealand.
George Smyth Baden Powell, Esq., Balliol College, Oxford.
William Ricketts Cooper, Esq., Sec. Soc. Biblical Archæology, 5, Richmond Grove, Barnsbury, N.
Charles Henry Marten, Esq., Combe Lodge, Charlton Road, Blackheath.
George Staley Mosse, Esq., 12, Eldon Road, Kensington.

Mr. Dunkin said that it was customary at the January meeting to appoint auditors, to examine the Society's accounts, he therefore moved the appointment of Mr. Brewin, Mr. Lecky, and Capt. Toynbee.

Mr. De la Rue seconded the motion, and no other candidates being proposed, the three gentlemen were declared to be duly elected.

Mr. Dunkin said he had been requested by the Astronomer-Royal, who was unable to be present in consequence of his being in the country, to say that he had endeavoured to finish his paper on the method to be used in the reduction of the observations of the transit of Venus, but had not been able to do so in time for reading at the meeting. He was still working at it, and hoped to have it ready by the next meeting. The Astronomer-Royal also wished it to be known that up to the present time he had not received any accounts from the expeditions stationed at Kerguelen's Land or the island of Rodriguez. No news even had been received of their arrival. By letters received from Capt. Browne and Capt. Abney, it appeared that the telegraphic report of the observations at Thebes was not quite accurate. The error arose through a confused telegraphic despatch by the clerk at Thebes. The internal contact was not actually included in the Janssen records, though they approached so near to it as to leave no sensible doubt about the time. The telegram said that internal contact was included in the Janssen plates, but this turned out to

have been a mistake. The turning of the handle began too soon, and it was exhausted before the contact took place. Mr. Dunkin went on to say: We have also received a letter from Colonel Tennant, who says the last photographs were missed by the stopping of the clock at Roorkee. But, by the combination of several circumstances, Colonel Tennant is satisfied he has fixed accurately upon the second of the internal contact, and notwithstanding the stoppage of the clock he is able to know the time; still it is unfortunate that the accident should have taken place.

The President: Janssen himself seems to have succeeded.

Mr. Dunkin: I have another subject I ought to bring before the Society—it has already been before the Council. Here is an invitation from the king of Siam to any astronomers who will go out to observe the solar eclipse of April 6th. I believe the duration of totality is about 4 minutes. It will be important, if any gentleman wishes to represent the Astronomical Society, that he should be prepared with good instruments, and he must be prepared to start directly. He may depend upon it he will be received in a right royal manner. The letter is from a gentleman with a very long name, and is addressed to the Siamese Consul in London, and is as follows:

"The Royal Palace, Bangkok,
"Oct. 9th, 1874.

"My dear Sir,—I have much pleasure in informing you that I have received the commands of His Majesty to request you to inform the Royal Astronomical Society, that if it will appoint men of science to observe the total eclipse of April next, His Majesty will be happy to consider them as his private guests during their visit, and will take on himself their entertainment, and provide them with transport for themselves and their instruments from Bangkok to the station selected by them, and back again, and will erect such temporary buildings as are required for them and their instruments. A communication to this effect will be made by his Excellency the Minister for Foreign Affairs to the Acting British Consul-General here, but as this will be slow in reaching the gentlemen interested, His Majesty has commanded me to address this note to you, relying on you to communicate it to the Society as soon as possible. I shall be most happy to receive any communication from the secretary of the Society named, and, if any gentlemen propose to avail themselves of His Majesty's invitation, I should wish to receive particulars of the probable number of the party or parties, of the station or stations proposed, and the foundations required for instruments—a plan, in fact, of each intended observatory, that I may submit them for His Majesty's orders. You may state

that our topographer, Captain Loftus, and other officers, who as surveyors are accustomed to precise observations, will be happy to assist if desired, and His Majesty will willingly release them from their other duties for this purpose. With the assurance of my high esteem, believe me, my dear Sir, your most faithful friend, (Signed) BHASHAKARAWONGSE.

"H.S.M. Private Secretary."

The President said this was not quite a general invitation, it was addressed to those who might be appointed by the Society to go out for this particular purpose.

Mr. De la Rue: I may state that a similar invitation has been sent to the Royal Society, which has taken action upon it by appointing a committee, which is now in communication with the government. It is proposed by the Royal Society to make a special series of observations, such as have not been attempted before. These observations have been proposed by Mr. Lockyer, and the committee of the Royal Society thought they were worthy of being carried out, provided there is time to admit of the necessary preparations. The observations are of this nature: to photograph the corona, not with the view of getting its configuration, but to photograph the spectrum of the corona at different heights, and, if possible, to obtain photographs of the bright lines of the spectrum as they appear when the totality commences and ends. The committee are in communication with the government, and have taken steps to communicate with India, to see if Colonel Tennant, and any of the gentlemen who have observed the transit of Venus with him, can be spared to take other observations with the instruments already out in India. The time is so extremely short that it is only just possible to reach Siam, and no more than just possible. It would, therefore, not suffice for any Fellows to state their willingness to go unless they were prepared to go at once, and to state to the Council what they would propose to do.

Mr. Dunkin: It would be no use to go single-handed, they must be provided with instruments.

Mr. De la Rue: It is quite possible that the Indian officers might reach Siam in time with the instruments already in India.

Mr. Ranyard: I should be glad if a photograph of the corona could be taken in the primary focus of a large instrument, so as to give us another opportunity of studying the remarkable details of the corona, similar to those that have been made out in the photographs of the last eclipse. It would be a great advantage if the photographs could be taken on a larger scale, but this involves larger instruments, or rather longer focussed instruments, and long exposures. This is not an eclipse that will be suitable for taking two series of photographs at a considerable distance

apart. We want two or three hours between the two series, and a very large scale before we can hope to trace any alteration in the form of the details during the duration of the eclipse, for it appears probable that the motion in the corona is not so rapid as in the chromosphere below. But first of all we want to determine whether the coronal structure varies with the sun-spot maxima and minima. I do not think that there will be sufficient intensity to give a photographic image of the spectrum of anything much higher than the chromosphere. I think we have proof that the bright lines form a very small portion of the total light of the corona.

Mr. Neison: I think there is an expedition going out to photograph the corona; Mr. Gill will take Lord Lindsay's instruments.

Mr. Ranyard: I fear that is only to be hoped for, it was not certain.

Mr. Neison: I understand that one of our members has gone to join him.

Mr. De la Rue: With reference to what Mr. Ranyard has stated, the Society should be made aware of the fact that in 1878 a very favourable opportunity will occur for observing and doing what Mr. Ranyard proposes, and other things. In North America an eclipse will take place of about the same duration, and our American friends are sure to take care that nothing escapes them that should be recorded.

Mr. Ranyard: I trust that the present opportunity of getting coronal photographs will, however, not be lost, for we are now nearer to a time of sun-spot minima than we shall be in 1878.

Mr. Dunkin then read a letter received from Lord Lindsay, dated "Mauritius, Dec. 10," and addressed to the Astronomer-Royal. It ran :—

"I feel sure that you will be glad to hear that my expedition has been in a great measure successful. After a long passage, delayed by head winds, we arrived on the 1st of November. By the 7th ult. all my instruments were up, and approximately adjusted. The weather at first was unfavourable, but latterly it has been fair. Mr. Gill has been able to get eleven entire sets of measures of the diurnal parallax of Juno, which, I hope, will give good results. Our longitude has been determined by 25 or 35 occultations (I forget the number), besides other methods, moon occultations, &c. You will have doubtless heard that my chronometers were sent to Rodriguez, by the "Shearwater," to assist Lieut. Neate in the determination of the difference of longitude between that island and Mauritius (observatory). I intend to connect my station with Mr. Meldrum's observatory, and so fill up the gap by telegraph. I shall also lay wires to the German station under Dr. Low. . . . .

"The morning of the 9th was cloudy before sunrise, and for a short time afterwards. The first external and first internal contacts were missed from this cause; we did not see the sun until 1 hour and 2 minutes after the first external contact, when it came out for a few minutes, and photographs and measures were obtained. It was not till 8 a.m. (local mean time) that it became fairly fine, and remained so with small periods of cloudy obscuration until the end of the transit.

"Photographs.—I took 271 plates, out of which number, perhaps, 110 will be of value. Cloud and the very high temperature of the camera were much against me. Temperature varying from 96 to 116 deg.

"Heliometer.—Mr. Gill obtained five complete determinations of greatest and least distance of the centres of the sun and Venus, besides nine measures of cusps, and two separate determinations of the diameter of Venus near the end of the transit.

"Six-inch Equatorial.—Dr. Copeland obtained, with this Equatorial and Airy Double Image Micrometer, 15 measures of least distance of Venus from the sun's limb, and ten measures of cusps. Dr. Copeland also observed the last internal and external contacts with this instrument. The images of Venus were brought into contact with each other, and then slowly-rotated by the position-circle, but they showed no symptom of oblateness (ellipticity). Dr. Copeland observed the second internal contact with full aperture and first surface reflecting prism. The second external contact was observed with the double image micrometer, the images superposed on account of faintness of the images.

"Four-inch Equatorial.—The last internal contact was observed with this instrument and the polarizing eye-piece by Mr. Gill. He also observed the last external contact with the heliometer. Both Dr. Copeland and Mr. Gill agreed that the contacts of Venus and the sun are remarkably similar to those seen in the model. They also agree that any phenomena which could be classed under the head 'black-drop' took place and disappeared within a period of five seconds.

"Transit Instrument.—Very accurate determinations of the time were obtained on the six nights previous, and one star and azimuth mark on the following by Dr. Copeland with the reversing transit. All the photographic exposures are automatically registered on the chronograph, by a method which gives the actual duration of the exposure. The heliometer observations were also registered there. Dr. Copeland observed by eye and ear; all other observations (photographic and heliometric) also observed by eye and ear as a check on the chronograph. During the actual work of the transit, I had eight assistants, not including

myself and Mr. Davis. Mr. Gill had six, including the Hon. Mr. Connal, Surveyor-General, to whom I am much indebted for valuable assistance. Dr. Copeland had three assistants. All these men formed part of the crew of my yacht; I had trained them to the work. I am happy to say that the German expedition under Dr. Low got the third and fourth contacts, with three complete sets of heliometric measures. Also, Mr. Meldrum got the second and first contacts, though rather uncertain as to the first internal contact, owing to cloud. Thinking that possibly he would not be able to get time determinations on the night of the 9th, I sent him a box of nine chronometers, which I have left with him, for the rating of his clock.

"May I ask you to be so good as to communicate this to the Royal Astronomical Society? The mail is just leaving, and so I have not time to write.

"P.S.—One of my photographs shows the second internal contact beautifully."

Mr. Dunkin: I have also an extract from a private letter from Admiral Ommanney to myself, which I have taken the liberty of copying. The letter is dated from Luxor:—

"I am glad to tell you that by a fortunate circumstance I have had the good fortune to share in observing the transit. At Cairo I became associated with Professor Auwers, of Berlin, and Dr. Dollen, of St. Petersburgh, who kindly allowed me to share in their expedition. We reached the station a fortnight previous to the transit, where we found Captain Abney and Colonel Campbell already established, with the observatory set up on an island south of Luxor, well situated for the object. As everything connected with the great phenomenon will interest you, I will now briefly inform you of the occurrence as it passed off with us. With regard to the condition of weather and atmosphere, everything was as favourable for making the observations as could be desired. The sun rose at 6h. 4m., a.m., local time, with great brilliancy and clearness, so common in Egypt; but on this occasion it was the clearest morning of any we had experienced since our arrival, not a cloud to be seen, and the Nile as smooth as a mirror.

"At the first glance it was a joyous sensation to see the dark orb of Venus on the disc of the sun, in her predicted place, making her way rapidly across towards the point of egress, more than three-quarters of her transit having apparently been accomplished. Professor Auwers had provided me with a telescope and chronometer; in all we were six observers. Captain Abney observed with the photo-heliograph, and Colonel A. Campbell with a very fine telescope belonging to Mr. Spottiswoode. Mrs. Campbell was provided with a good telescope also, and she acquitted her-

self most creditably and zealously in the work. Professors Auwers and Dollen each had a telescope, and previously to the contact the former took measures of Venus with a heliometer. Every one had gone through constant practice with models night and day, so we may anticipate that the combined observations from this station will be valuable.

"Each observer was at his station at sunrise. Silence was observed, and the intense interest we felt during the brief period of observation you can easily imagine. At first the outline of Venus was rather jagged, owing to vibration of the atmosphere, but as the altitude increased this disappeared; and towards internal contact, both the edge of Venus and the outline of the sun's limb, as well as at the moment of contact the definition was remarkably clear, but although I watched with all possible attention, I could not detect the appearance of a black drop.

"Immediately after the internal contact at egress, however, a remarkable phenomenon presented itself; that portion of Venus which had emerged from the sun's limb became illuminated with a white border, which light continued on the edge of the cusp of Venus with great clearness, until the time when half of the planet had crossed the sun's limb; then the light diminished, and disappeared about seven minutes before the last external contact.

"The precise moment of last external contact was to my mind the most difficult to define. I will now give you the local mean time by my observation, after applying the correction for the error of chronometer:—Last internal contact at egress, 20h. 16m. 5·6s.; last external contact at egress, 20h. 44m. 28·1s. On our comparing notes, professional astronomers consider that our discrepancies are quite within reasonable bounds. My companions—Professor Auwers and Dr. Dollen—will make their reports to their own authorities before letting any one else see them, so I cannot give you their results. They have obtained a great many observations for fixing their positions. You will have a very valuable record of the transit from the sun pictures obtained at every two minutes' interval during the transit, and also from several taken by Janssen's plates.

"Luxor, Egypt: Dec. 12, 1874."

Mr. Ranyard: I have another communication received by Mr. Browning from Colonel Campbell, who was at the same station:—
"Now that the transit is over, I can write a few lines. We were most wonderfully fortunate. The morning was perfection. I made the internal contact at 8h. 16m. 10·6s., and the Hon. Mrs. Campbell at 8h. 16m. 9·7s.; the solar time at 2h. 10m. 45s. Mrs. Campbell has always been before me with the model. Dr. Dollen was put out by a light which appeared on the leading edge

of Venus just before contact—a silver thread; but I saw at once that it was not the light of the sun, but more like the moon. We thus regarded it. There was no black drop proper, only a very faint shadow and a few interference lines. Venus was visible till half her diameter was over the sun surrounded by this faint silver light. Fourteen minutes after contact there was like a bit bitten out of a biscuit, and at 8h. 44m. 41·6s. the last external contact took place."

Mr. Ranyard: He does not say whether the line was upon Venus or on the sun, or whether it corresponded with the line seen during eclipses on the sun along the moon's limb, or whether the line was on the dark body of Venus.

Mr. Dunkin: Admiral Ommanney says that portion of Venus which had emerged from the sun—he therefore means that the line was on the body of Venus.

Captain Noble: As if the sun's light were refracted by the atmosphere of Venus.

The President: I have now to invite any remarks from members of the Society on these communications.

There being no response to this invitation,

Mr. Dunkin read a letter from Mr. Hind, addressed to the President:—

3, Verulam Buildings, Gray's Inn, W.C.
January 8, 1875.

My dear Sir,

The observations of time of second internal contact of Venus with sun at Mount Mokattim, published in the last number of the *Monthly Notices* quite confirms the inference in my former letter, which was founded upon an observation at Alexandria. Taking a mean of the two sidereal times of contact at Mokattim, or 13h. 22m. 23s., with the longitude given on the following page by the Astronomer-Royal, I find the local mean time, 20h. 11m. 6·9s.

Le Verrier's tables of sun and planet, with the semi-diameters for transits recommended in the introduction to the Tables of Venus give 20h. 11m. 12·3s.

Carlini's sun and Lindenau's Venus, with addition of Airy's long inequality of Venus and the earth, and our old semi-diameters (but 8″·9 for sun's horizontal parallax) give 19h. 57m. 33·3s.

So that the error of calculation by Le Verrier's tables is + 5s. And that by the tables of Lindenau and Carlini, with Airy's long inequality = — 13m. 34s.

I am, my dear Sir,
Yours very truly,
J. R. Hind.

Mr. De la Rue: I think it worth while to call attention to the fact, which has come out in the observations of the transit of Venus, at very nearly the same stations in Egypt, that there is some difference between Captain Browne's time of the last internal contact with the Lee telescope, and that of the gentleman who observed with the telescope bearing the name of De la Rue, but which is really a telescope made by Dallmeyer, and lent by me. The difference of time is very considerable, if I recollect rightly, four seconds, and I want to ascertain the opinions of the Fellows of this Society on the cause of this, which is certainly only in part a personal question—a question of the difference of eyes—but it must also, I think, have something to do with the definition and the apertures of the telescopes. A difference of four seconds at the same station must cause a difficulty in the reduction of the observations. It may partly depend on the eye of the observer, but it must, I should think, depend upon the apertures, and the correction of the spherical aberration of the several telescopes, and unless these things are taken into consideration I imagine there will be many difficulties. The telescopes ought to be brought from the stations in order that they may be compared by all the observers. We know very well that some telescopes will separate double stars very close together, that others will not, even though they have a larger aperture; and though that is not quite the same thing as the definition of a fine line of light on the limb of the sun at egress, still it is intimately connected with it, and I think it very important to call the attention of the Society to it.

The President: Was there any difference between the phenomena with regard to the black drop?

Mr. De la Rue: No black drop was seen, I think. The time with the Lee telescope was 13h. 22m. 25s,, and with the Dallmeyer 13h. 22m. 21s. It is a curious thing there should be a difference of four seconds at the same place.

Captain Noble: What was the aperture of the Lee telescope?

Mr. De la Rue: Nearly six inches.

Captain Noble: With reference to this, I think that, *cæteris paribus*, the shorter the focal length the greater is the separating power, but before giving an opinion upon it, I should like to know the comparative apertures and focal lengths of the two telescopes.

Mr. Christie: The Astronomer-Royal has been very careful to direct his attention to this matter in the preparations for the transit of Venus. The observers have made careful observations, not only to determine the difference between the different observers, but also the difference between the different telescopes;

and I think nearly all the telescopes were compared in this way. I am not quite sure that Mr. De la Rue's telescope (Dallmeyer's) was so compared, because it was only received at the last moment, but as a general principle they were. The result was that while there was a marked personality in the observers, there was also a marked difference between the results given by different telescopes; the telescopes of greater aperture make the egress later than those of smaller aperture. I do not see anything peculiar in this discrepancy of four seconds. Mr. De la Rue's telescope has a smaller aperture, and that would accord with the fact of the Lee giving a smaller irradiation and a better defining power than the telescope of smaller aperture.

Captain Noble: I recollect making an observation, at Greenwich, with your model, with a gentleman who had a larger telescope than I had, and we made less than half a second difference.

Mr. Christie: There was a marked difference in the result after many comparisions of a large number of observations. At the same time, I do not see, myself, how the focal length of the telescope can have any effect on the dividing power.

Captain Noble: If you have, *cæteris paribus,* two telescopes of the same aperture, but of different focal length, the one of the shorter focus will appear to separate the double star most; as a matter of practice it is so.

Mr. Christie: Practically, we did not find that difference with the model.

Mr. Knott: With regard to the practical question, referred to by Captain Noble, I think it is stated by Mr. Dawes in his last series of measures of double stars, that he had found that the focal length had nothing to do with the separating power, but that if the telescope was good, the separation would be according to the aperture.

Captain Noble: Mr. Knott, who is one of our greatest authorities on double stars, is quite right about the effect of the aperture on the separating power; equal apertures cause an equal removal of the centres of the discs from one another; but the short focus acts in diminishing the discs. It is not that the centres are moved farther apart by the object glass of shorter focus, but that through the shorter focal length the discs become smaller.

Mr. Ranyard: That is just the point, to ascertain whether the discs become more separated. Theoretically they do not.

Captain Noble: As a matter of fact you will find they do. If you were to give me a short focussed telescope of equal definition and aperture with a long focussed telescope, you would find that the short focussed telescope separated best.

Mr. Christie: Captain Noble's point is very clear; but the

diameter of the disc of a star subtends the same angle at the centre of the object glass, whatever the focal length, provided the aperture be the same, so that you gain nothing by having a shorter or a longer focus, except in the way of correcting the spherical and chromatic aberration, which can be best done with a long focus. The angular interval between the discs of two stars nearly in contact is the same whether you have a long or short focus, therefore the separating power of the telescope is the same.

Mr. Ranyard: There is this to be said, although we know from the principles of the undulatory theory that the angular diameter of the diffraction disc of a star, as seen from the centre of the object glass, is a function of the aperture, and does not vary appreciably with the focal length, yet it must be remembered that with a short focussed telescope the centres of the discs of two stars will be actually less separated in the principal focus than with a long focussed telescope. The eye-piece only magnifies the image and will not separate discs that are not already separated in the principal focus; with the short focussed telescope a higher powered eye-piece will be necessary to give the same power, and its deeper curves will give worse definition. So that there is a reason why a long focussed telescope should separate discs better than a short focussed telescope of the same power and aperture. Sir John Herschel used, I believe, to recommend the use of a triangular diaphragm in front of the object glass to separate close double stars.

Mr. De la Rue: With reference to diminishing the aperture of a telescope in order to produce a separation of double stars, I would ask Mr. Lassell, who has had great experience, whether, taking equal areas, it would be better to use the outer half of an object glass, or the inner half?

Mr. Lassell: With equal areas, that is to say, the annulus being equal to the disc, you would get the best division from the disc and the greater definition from the annulus.

Mr. De la Rue: That is my experience, too.

Mr. Mattiew Williams said, in reference to the transit observations and the difference of time, if there were deep spots on the edge of the photosphere as Venus came on or went off, they might have a slight effect on the time of ingress or egress, according as Venus was seen projected on a higher or lower part of the limb, and this would become a source of error.

The President: That would throw no light on the difference between observations taken at the same place.

Mr. Williams: My remarks refer to a general source of error which appears to have been overlooked, not to the particular differences just described.

Mr. Dunkin read a paper by Dr. Schultz on a "*Preliminary Catalogue of Nebulæ observed at Upsala.*" This was a catalogue of some 400 or 500 nebulæ. Dr. Schultz had already published observations of these nebulæ; the probable errors of these results are remarkable considering the difficulty of observing nebulæ accurately, and the selection of points for observation. Dr. Schultz had brought the probable error down to a very small quantity indeed, so small that one could hardly conceive that observations of nebulæ could be made so accurately.

Captain Noble suggested that Dr. Schultz had only selected from Herschel's catalogue those which have a very positive nucleus.

The President: No doubt, as a matter of course, they would be selected.

Mr. Dunkin said, the observations formed the basis for a determination of their proper motions, which was a very important matter, as without good observations now such determinations would not be of value for comparison a hundred years hence.

The following papers were also announced and partly read:—

Further Ring Micrometer Observations of Coggia's Comet (III., 1874): by Mr. Tebbutt.

Note on the probable disappearance of two stars of the 6th mag., from the cluster B.A.C. 2694: by Mr. Tebbutt.

On Proctor's Equal Surface Chart: by Mr. H. M. Parkhurst.

Observations of Occultations of Stars by the Moon, and of phenomena of Jupiter's Satellites, made at the Royal Observatory, Greenwich, in the year 1874: by Sir G. B. Airy, K.C.B., F.R.S.

Observations of the Solar Eclipse of 1874, *Oct.* 9, *made at the Royal Observatory, Greenwich*: by Sir G. B. Airy, K.C.B., F.R.S.

Ephemeris of physical observations of Jupiter: by Mr. Marth.

The meeting adjourned at half-past nine.

THE TRANSIT OF VENUS.

To the Editor of *The Times.*

Sir,—A letter addressed by Dr. Phipson to a French journal, expressing the opinion that the recent transit observations are useless, because the earth is continually drawing nearer to the sun, has attracted some attention. Many seem to think that the scientific expeditions were little better than a wild-goose chase. Indeed, in the *Univers*, a copy of which has just been sent to me, "The recent wild escapade of those wiseacres, the astronomers," is treated as, in a sense, a judgment on scientists—"Darwins and

Tyndalls, and Huxleys and Gladstones" (*sic*) for "their assertions respecting the creation of the world and of man."

It would be something beyond a joke if Dr. Phipson were right, and therefore it may be as well to point out that while during the last century there has been uncertainty about the sun's distance, even to the extent of millions of miles, astronomers are absolutely certain that the distance has not varied by a hundred, or even by ten miles during that time. I think it was Dr. Phipson who first advanced the startling theory that the great difference between Encke's estimate of the sun's distance (more than 95 millions of miles) and the present estimate (less than 92 millions) represented a real change in the sun's distance since the transit of 1796. It may comfort those who may have been alarmed by this statement to mention that if the earth had thus drawn nearer by one-thirtieth of her former distance, the length of the year would have changed by one-twentieth of its former length, or by 18 days. A change of only 10 miles in the last 100 years would correspond to a change of more than 300 miles since the length of the year was first determined very exactly. This would be about a 300,000th of the sun's distance, and the length of the year would have been changed by about a 200,000th part—that is by about 2½ minutes. Now it is known that the Chaldean sidereal year, probably far more ancient than the above reasoning assumes, contained 365 days 6 hours and 11 minutes, being not quite two minutes too great. The sun's distance might, therefore, be diminishing by about eight miles per century. But in reality we have no evidence in support of such a theory, seeing that the Chaldeans professedly selected such a value for the year as would make their *Saros* contain an exact number of hours. The true value of the *Saros*, according to our best modern estimates, should have been 6,585 days 7 hours 40 minutes 38 seconds, and they made the value 6,585 days 8 hours. Considering that astronomers will be well satisfied if they can determine the sun's distance within 100,000 miles, it is clear that the *maximum* change of distance we can admit, by which 1,000,000 years would be required to bring the earth 100,000 miles nearer to the sun, is not a very important point in the inquiry.

Permit me to make a remark or two on the reference to M. Puiseux in your Wednesday's article on the Transit—not assuredly to assert any claim to priority (which would be a feeble-minded proceeding, indicative of mental barrenness), but to prevent possible misapprehension. I believe Puiseux's opinion as to Halley's method and Delisle's was not known to any one outside the French Commission until February, 1869. About that time I communicated privately to Sir G. Airy the results of my own calculations,

and about a fortnight later (to the best of my recollection) Mr. Stone, of Greenwich, called my attention to Puiseux's paper, then first known to me. My results were not only independently worked out, but were carried to a higher order of approximation. In Puiseux's paper the centre of Venus was dealt with and the curvature of her shadow cone was neglected (the ordinary method in a first approximation). In mine Venus was dealt with as a globe, and the variable motion of her shadow's edge across the earth, owing to curvature, was taken into account. I think that in all my published works relating to this matter I have described Puiseux's researches and mentioned his priority (by a few days) so far as I was myself informed on those points. The question, however, of the use of Halley's method was never a very important one, though it somehow secured more attention than others. The whole scheme of operations required re-examination. In fact, the closing paragraph of your article well presents the conclusion to which the late controversy points. In preparing for the Transit of 1882, a Commission should be appointed, including those best qualified to pronounce an opinion on the physical, geometrical, meteorological, instrumental, and other relations which have to be considered in providing for scientific expeditions. With a Commission selected from men like Adams, Cayley, Hind, Challis, De la Rue, Huggins, Lockyer, Lassell, Beckett, Main, Toynbee, Strange, Tupman, Ranyard, Abney, and the rest, we may secure arrangements which will not leave England a decade of years behind the other nations in the work of Transit observation, but give her a foremost position. Besides, as you well remark, official astronomers would thus "be shielded from a responsibility too great for individuals to bear."

RICHARD A. PROCTOR.

THE TRANSIT OF VENUS.

Abridged from *The Times*, January 9th, 1875.

The further news which we have received from the Mauritius is much more hopeful than that telegraphed by Lord Lindsay, for it includes an account of the doings of Mr. Meldrum, the director of the Government Observatory in that island.

We pointed out in our impression of Dec. 28 that what was most important to the English plans was an observation of the ingress of the planet. Now, Mr. Meldrum (having only a few weeks before the transit been provided, by the wise forethought of the Colonial Government, with a perfect telescope of six inches aperture, by Cooke, of York) has been fortunate enough to obtain an observation of the ingress although both Lord Lindsay and the German party were prevented from doing this by the cloudy state of the sky. But, although Mr. Meldrum obtained the two interior contacts, clouds and haze were at intervals passing over the sun, which, in fact, was obscured during the greater part of the transit, passing

showers of rain not being wanting to harass the observers. At times, beautiful definitions of the planet were observed, especially soon after the first interior contact. Then there was a long period of obscuration, after which, most fortunately, the sun shone out for the second interior contact. Only the first interior contact was lost, the sun not appearing at all until 6h. 16m. A few minutes before the last interior contact the sun was again obscured, and when the clouds passed away the transit was over.

With regard to the operations of the party sent out by the Government of Holland to Réunion, it appears that there, as at Mauritius, the ingress was missed altogether, in consequence of the bad weather. The second interior contact was observed both by Dr. Oudemans and Dr. Soeters, not the least trace of the black drop being observed. Although the chief of the photographic division of the Commission had prepared 130 dry plates, only nineteen could be exposed, and of these only two or three are considered of value, the others apparently have been under-exposed.

The observations with the heliometer were more successful. The party, instead of measuring the distance of the planet from the sun's edge along a radius, had calculated beforehand, for each ten minutes, the direction of the most favourable chord for determining the relative parallax of Venus; two sets of eight measures of this kind were recorded.

We have yet to hear from Rodriguez. In case of failure at that station and at Kerguelen's Land, the only observation secured to pair with those made at the Sandwich Islands in order to apply the method of Delisle at ingress is the one secured by Mr. Meldrum.

The following observations, made at Colombo by Mr. George Wall, and communicated to the *Ceylon Times*, are of great interest, as here is again recorded an exact reproduction of the appearance observed by Chappe d'Auteroche, in 1769, to which we have already drawn attention:—

"The weather favoured our observations. The first external contact was not recorded, as the sun was so low that the definition was imperfect. The two internal contacts were well seen. Having carefully read up the subject for some time past, we were prepared for the difficulty of the black drop, and had our attention steadily fixed on that expected phenomenon. An unforeseen appearance, however, surprised us, and before the planet had become two-thirds immersed in the solar disc, a fine clear, delicate line of faint light was seen round the outer limb. This line became clearer and more marked as the planet approached its internal contact, and caused an unexpected difficulty in determining the instant of contact. My companion, Mr. M'M——, at the four inch, and myself at the six inch telescope, sat in profound silence, listening to our chronometers and clock at this exciting moment, he observing the black drop and noting the instant of its rupture, while my instrument showed only the clear but faint line of light which defined the planet's periphery and prevented the appearance of the drop. In the large instrument the sun's disc showed a slight indentation some seconds before internal contact was complete; but this appearance, which should have narrowed and contracted as the immersion advanced, disappeared, and left the faint but clear thin line of light round the planet's limb still external to the solar disc to mask the critical event! This, however, was recorded with as much accuracy as circumstances permitted. The last internal contact was not quite so favourably seen, as passing clouds cast an occasional and varying shade over the sun. Its time, however, was also taken with all care. The long interval between the contacts was generally cloudy. It remains to be seen whether the Astronomer-Royal had anticipated the curious and beautiful phenomenon which so effectually perplexed our

observations. The times of internal contact were roughly :—7h. 40m. 15s. local mean time, and 11h. 52m. 53s., subject, however, to correction."

It is clear that science will lose much from an incomplete discussion of all the observations made in 1761 and 1769.

Abridged from the *Times*, January 20, 1875.

The detailed news from the more distant stations, except in the extreme south, is now coming in slowly. We have to-day to chronicle especially French and Italian successes. With regard to the southern stations, it is clear that Mr. Green's attempt to obtain information at Kerguelen's Land, and to carry it to Melbourne, has failed, for we as yet are entirely ignorant as to what happened at that station of critical importance.

The French news to which we have referred consists of telegrams from Shanghai in the Northern and from New Caledonia in the Southern Hemisphere. From the former station M. Fleuriais, the astronomer in charge in Pekin, now states that he was fortunate enough to observe all the four contacts, and not two only, as was at first stated. The times were as follows in local mean time:—First contact, 21h. 32m. 42s.; second 22h.; third, 1h. 50m. 15s.; fourth, 2h. 17m. 13s. Nor is this all; no less than 60 photographs were taken, which M. Fleuriais pronounces good. We have already stated that stations in Northern China are most useful for the application of the Halleyan and direct methods. From New Caledonia the best part of the news refers to the photographic operations, 100 good photographs being secured. Of the contacts only the interior one at ingress was observed.

Besides this news of the results of the expeditions, a most interesting letter was read at the last meeting of the French Academy from M. Janssen, stating how a close study of the local weather conditions had induced him to give up Yokohama for Nagasaki. This is not the first time that M. Janssen has shown how important a serious inquiry into local meteorology is to astronomical observers in expeditions of this kind.

The news of the doings of the Italians comes from the party in Bengal in charge of the distinguished spectroscopist Tacchini, including Dorna, Lafont, Morso, Abetti, and Tacchini. The telegram comes from Maddapore, and the party evidently occupied two stations. The first three observed all four contacts, the last two only the third and fourth.

As we have before stated, the chief instrument employed by the Italians was the spectroscope—an instrument not recognized in the equipment of any of the English parties.

The observations were of the most satisfactory kind, and the results may lead to a most important discovery in solar physics. The time of interior contact at egress was observed with the most rigorous exactness, both by the ordinary telescopic method and by the spectroscopic method, described in our former Notes. It was found that the difference between the times of observation by these methods *was more than two minutes*, contact being observed by the spectroscope first. Now, if the contact had been observed last by the spectroscope there was an obvious condition of the observation to which the dis-accord might have been attributed; but there is now no room for doubt that the sun's extreme edge which we actually see in a telescope differs physically from the part just within it, although there is no difference to the eye—in fact, that it gives a spectrum of bright lines, while the spectrum of the true subjacent sun gives a continuous spectrum with dark lines. Further, the physical difference to which we refer would probably tend to make this stratum variable in thickness and luminosity. Nay, we may already

hazard the question whether there is not here a condition which may have something to do with the various times of contact recorded by observers, having object-glasses widely differing either in aperture or in the over—or under—correction of the chromatic dispersion.

Another victory achieved by the Italians is the determination of the nature of the atmosphere of Venus. The ring round the planet, which in the former transits as in the present one was visible round Venus both on and off the sun, indicates in the spectroscope that in that planet, as in our own, the atmosphere is composed to a certain extent of aqueous vapour.

(To be continued.)

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

SOLAR SPECTRUM.

Translation of Dr. Vogel's Article with regard to the employment of Gratings for observing the Lines in the Spectrum.

As a third method of observing the spectra of stars may be mentioned the employment of interference gratings—a plan which has decidedly not yet met with the attention that it merits. A grating may be employed either in front of the object-glass, or it may be used at the eye-end of the telescope instead of the prisms of a compound spectral apparatus. It is principally to be attributed to the difficulty of executing gratings of considerable size that nothing has as yet been published upon the experiments made therewith. Already more than a year ago, I entered upon investigations in this direction, and, notwithstanding the material diminution of light produced by the use of a grating placed before the object-glass, I think it not improbable this method may be had recourse to with advantage for the examination of tolerably bright stars. With the planetary nebula, H 2098, which shows the well-known spectrum with 3 lines, the images of the nebula corresponding with the lines could be tolerably well seen, while the spectra of bright stars were sufficiently intense to admit of measures being effected therein. It is my intention to resume this enquiry ere long with more suitable means than as yet are at my disposal, and shall then be in a position to speak more definitely as to the applicability of this method of observing. As an advantage that it presents may be cited that by means of its measurements the wave-lengths may be ascertained directly, and that—as the diffraction spectra on both sides of the centre are so situated that the sequence of the colours on one side is is the reverse of that in which it occurs on the other side—the magnitude of any displacement that takes place, owing to the approach or retiring of a star with respect to the earth, is shown to a DOUBLE amount when the distance of one and the same line in the spectra is determined right and left from the centre. The substitution of a fine diffraction grating for the prisms at the eye-end of the telescope, in the case of spectroscopes provided with a slit, seems, therefore, first of all, to present advantages, owing to the dimensions of the apparatus remaining unaltered, let the amount of the dispersion be what it may. And as, in addition, the

extension of the separate colours is proportional to their wave-length, the less refrangible portions of the diffraction spectrum, compared with those produced by prisms, are of greater extent, and consequently better fitted for the examination of prominences in the red and the yellow. Already, some time ago, my attention was directed to the construction of a spectral apparatus of this nature, and I have only been prevented from carrying the idea out practically in consequence of the expense of a diffraction-grating with fine lines. The labours of Angström upon the Solar Spectrum, which as we are aware were carried out with diffraction gratings, establish beyond a doubt a successful result. Professor Young in the United States has, as I have heard, recently used diffraction-gratings for observing protuberances.

Thus far Dr. Vogel. As yet, however, gratings have been made of only small size, the largest that I know of, at least, being only two inches and a half long and an inch high, and having not quite 700 lines to the inch. Can any of your readers say whether larger and closer ruled gratings have been employed in this country as Dr. Vogel suggests, and, if so, with what results?

I am, sir, yours faithfully,
R. T.

FINE METEOR.

Dear Sir,—While standing in the conservatory after 10 p.m., I saw a very bright meteor traverse the sky in the S.E. As seen through the moist glass it closely resembled Sirius, which was then very bright. It started at a point as far to the east of Sirius as that star was from the horizon. Its path was nearly horizontal, but slightly falling, and the meteor disappeared at a point half-way between Sirius and the horizon. It was visible 3 seconds. On running to the observatory I found that the time of disappearance was about 10h. 25m. p.m. When I got out into the open air I could not detect any trace of a luminous train. Clouds soon came on and prevented angular measurements by which to determine the the length of path, &c., more accurately.

Mr. E. Crossley's Observatory, Halifax: Dec. 17, 1874.

I am, sir, yours very truly,
JOSEPH GLEDHILL, F.R.A.S., &c.

HALO.

Sir,—On the 30th December, I saw a very fine display of halos and mock suns.

Around the sun at the distance of about 20° was an ordinary halo, in which were two parhelia, slightly above the level of the sun, and at the top was a bright orange and yellow arc of a tangent circle. Exterior to this was another halo, at about twice the distance of the first, and coloured like the rainbow, which it resembled, except that the red was on the inner side. There was also a vertical ray of light through the sun, and opposite to it, in the north-west, was a parenthelion, or column of light similar to the one passing through the sun.

I watched the phenomenon from 10 to 10.30 a.m., when it had almost disappeared.

It was followed in a few days by a thaw and falls of rain.

Writtle, near Chelmsford: Jan. 9, 1875.

Yours truly,
HENRY CORDER.

THE TRANSIT OF VENUS.

Sir,—The transit was well seen here, the sky being beautifully clear during the whole duration. With a 3-inch refractor I could see nothing of the so-called "black drop," at ingress. At egress, a very small ligament was formed a few seconds before the internal contact. At ingress, I distinctly saw the disc of Venus outside the sun's limb, owing to a faint ring of light which surrounded it, caused probably by refraction through the planet's atmosphere. While the planet was on the sun I could not see any light on the disc, nor any trace of a halo round the planet, which seems to have been noticed during the transit of 1769 by some observers. No trace whatever of a satellite was visible in my instrument with a power of 133 diameters. Your obedient servant,

Punjab, India: Dec. 19, 1874. J. E. GORE, C.E.

STAR MAGNITUDES.

Sir,—With reference to Mr. Backhouse's letter on μ Draconis (p. 170), the star seems to be now of the fifth mag., and about equal to 30 Draconis, near γ; it is marked on most star maps as fourth mag. It would be interesting if its variability was confirmed, as it is a binary with the components nearly equal.

There are some other cases I have noticed, in which variation may be suspected. For instance o Pegasi, a little south of η, marked in Mr. Proctor's atlas as 6th mag., seems now fully 4th mag., and about equal to 56, δ of β. In the same constellation ξ (5th mag.), between α and ζ, is now much brighter than 31 Pegasi (4th mag.) a little to the west. I have remarked other discrepancies in star maps, and it seems difficult to believe that *all* these are due merely to errors in observation.

Umballa, Punjab. I am, sir, your obedient servant,

Sept. 5, 1874. J. E. GORE.

ω^1 *CANCRI.*

Sir,—In the November number of the *Astronomical Register*, Mr. Burnham asks for observations of the double star ω^1 Cancri.

Mr. Buckingham mentioned the star to me as double at the meeting of the Astronomical Society, on April 12th, 1872, and on the following evening, Saturday, April 13th, I observed it with my $7\frac{1}{3}$-inch Alvan-Clark refractor, mag. power 277, with these results, which I copy from my journal:—

"ω^1 Cancri. A 6 mag. golden. B $11\frac{1}{2}$ mag. grey or greyish blue. P. = 340°, D. = 2″, both estimated. A charming object."

I am unable to explain the discrepancy between the angle of position as noted by me, and that given by Mr. Webb in his "Celestial Objects." This is the only occasion on which the star was observed by me.

I am, sir, yours faithfully,

Cuckfield: Nov. 6, 1874. GEORGE KNOTT.

Books &c., received.—"The Transit of Venus." By T. H. Budd. Longmans, Green & Co. 1875.—"Carbon and Hydrocarbon in the Spectroscope." By Piazzi Smyth. Taylor and Francis. 1875.—Rev. E. L. Berthon's Models of the Transit of Venus. Horne and Thornthwaite. Holborn Viaduct. W. R. Birt's "Contributions to Selenography." Taylor and Francis. 1874.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN FEBRUARY, 1875.

BY W. R. BIRT, F.R.A.S., F.M.S.

Zone XX. British Association map, 45° to 50° S. latitude.

Mare Australe (Z) (*a*) 25°, Steinheil (385) (*b*) 2°, Janssen (473) the south part, Lockyer (480) 5°, Pitiscus (386) (*c*) 10°, Barocius (359), Clairaut (357), Cuvier (356) the north part, Licetus (355) (*d*) 7°, Maginus (195) (*e*) the north part, Street (182), Smith ( ) (*f*), Wilhelm I. (191) the south part, Longomontanus (192) (*g*) the north part 15°, Schiller (234) (*h*) the north part 10°, Schickard (239) (*q*) the south part, Wargentin (243) (*k*) 10°, Inghirami (244).

(*a*) See Vol. XII., p. 304, foot note (*a*) errata, line 3 for (2) read (Z), and for (3) read (*a*).

(*b*) Steinheil is considered to be one of the deepest of the double rings, sinking in one place to 12,000 feet. Between it and the Mare Australe are several large craters at present unnamed, particularly four in about 70° W. longitude. None of these craters are shown on Webb's index map.

(*c*) There are several unnamed craters in this zone, situated to the north-east of Pitiscus.

(*d*) Several unnamed craters occur to the south-east of Licetus.

(*e*) Maginus, as is well known, is a magnificent formation ; it is, however, but little studied, although it deserves the most scrupulous attention. Webb in his Celestial Objects, third edit., p. 106, describes it as the ruin of a vast complex ring, and mentions some minute hillocks and a little hollow in its centre. What is the present condition of these hillocks and hollow?

(*f*) Street and Smith are delineated as distinctly walled craters in T. LV. of Schröter's Fragments. They are situated on the south of Tycho. On Beer and Mädler's map they appear as imperfect craters.

(*g*) Longomontanus. For a notice of this fine ring and its more interesting neighbourhood, see Webb, third edit. pp. 105, 106.

(*h*) The reader will find a drawing of Schiller by Schröter in T. XLVIII. of his Fragments. The region delineated in T. XLVIII. is one of great interest, and should be studied with Schröter's drawing before the observer.

(*i*) Schickard. This fine plain, which is curiously varied as to colour, has been but little studied. Consult Webb p. 110 for some of its most prominent features.

(*k*) Wargentin. Adjoining this unique object on the west is an unnamed crater of about the same size. Schröter in T. LXXI. gives two drawings of it at figs. 44 and 45. Webb, p. 110, speaks of it as resembling a large thin cheese. A very fine illustration of Wargentin will be found in Nasmyth's and Carpenter's Book on the moon. No opportunity should be allowed to pass without comparing Schröter's and Nasmyth's drawings with the appearance presented by this remarkable object in the telescope. Schröter gives some curious markings on its surface, which ought to be studied as closely as the surface of Plato has been.

Six years have nearly elapsed since the observations of the floor of Plato were commenced, and it is now nearly four years since they were discontinued systematically. Will not a few active amateurs rally for another attack on some similarly constituted spots on the moon's surface? Of several of the fine objects to be found in zone XX but little is known beyond their names. The full moon knows no Maginus! Why? Will not a good lunar draughtsman undertake to produce a series of drawings of the appearance of this fine plain from sun-rise to sun-set, if it be only as an incentive to further selenographical work?

ASTRONOMICAL OCCURRENCES FOR FEBRUARY, 1875.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
Mon	1	23	Opposition of Uranus Sidereal Time at Mean Noon, 20h. 45m. 8·35s.	1st Ec. D. 1st Oc. R.	14 25 6 17 48	α Orionis — 9 1·8
Tues	2	1	Conjunction of Moon and Venus, 9° 5′ N. Sun's Meridian Passage 13m. 57·66s. after Mean Noon	1st Tr. I. 1st Sh. E. 1st Tr. E.	12 44 13 44 14 55	8 57·9
Wed	3			1st Oc. R. 3rd Sh. I. 3rd Sh. E.	12 15 15 3 17 31	8 53·9
Thur	4			2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	15 28 17 53 18 0	8 50·0
Fri	5	19 54 10 17	● New Moon Conjunction of Sun and Saturn Conjunction of Moon and Saturn, 3° 48′ N.			8 46·1
Sat	6			2nd Oc. R.	14 29	8 42·1
Sun	7	0	Conjunction of Moon and Mercury, 3° 21′ N.	3rd Oc. R. 1st Sh. I.	12 13 18 56	8 38·2
Mon	8			1st Ec. D.	16 18 20	8 34·3
Tues	9			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 24 14 34 15 37 16 46	8 30·3
Wed	10	4 35 5 12	Occultation of 88 Piscium (6) Reappearance of ditto Saturn's Ring: Major axis=34″·50 Minor axis=8″·78	1st Oc. R. 3rd Sh, I.	14 6 19 0	Moon. — 3 44·7
Thur	11			2nd Sh. I.	18 3	4 34·2
Fri	12	17 20 7 32	☽ Moon's First Quarter Near approach of δ Arietis (4½)	2nd Oc. R.	16 57	5 6·5
Sat	13	6 41 7 41 13	Occultation of 36 Tauri (6) Reappearance of ditto Conjunction of Mars and β^1 Scorpii (2·1m.) E.	2nd Ec. D. 2nd Oc. R.	12 14 34 16 57	6 22·2
Sun	14	11	Conjunction of Mars and β^1 Scorpii 0° 7′ N. Illuminated portion of disc of Venus=0·477 Illuminated portion of disc of Mars=0·896	3rd Ec. R. 3rd Oc. D. 3rd Oc. R.	11 33 51 14 4 15 56	7 21·3

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon.
Mon	15			2nd Tr. E. 1st Ec. D.	12 3 18 11 34	— 8 22·3
Tues	16	6 40	Near approach of 47 Geminorum (6) Sidereal Time at Mean Noon 21h. 44m. 16·69s.	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	15 17 16 24 17 30 18 35	9 23·1
Wed	17	11 11 12 9	Occultation of λ Cancri (6) Reappearance of ditto	1st Ec. D. 1st Oc. R.	12 39 51 15 55	10 21·2
Thur	18		Sun's Meridian Passage 14m. 11·29s. after Mean Noon	1st Sh. E. 1st Tr. E.	11 59 13 3	11 15·1
Fri	19	20 1 16 42 17 17	○ Full Moon Occultation of 37 Leonis (6) Reappearance of ditto			12 4·5
Sat	20	6 25 7 16	Occultation of *l* Leonis (5) Reappearance of ditto	2nd Ec. D.	14 48 40	12 50·1
Sun	21			3rd Ec. D. 3rd Ec. R. 3rd Oc. D.	13 18 31 15 30 30 17 45	α Orionis — 7 43·1
Mon	22			2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	12 3 12 26 14 28	7 39·2
Tues	23			1st Sh. I. 1st Tr. I.	17 10 18 13	7 35·3
Wed	24	18 30 19 43 19	Occultation of B.A.C. 4679 (6½) Reappearance of ditto Conjunction of Moon and Jupiter, 2° 55′ N.	1st Ec. D. 1st Oc. R.	14 33 7 17 44	7 31·3
Thur	25			1st Sh. I. 1st Tr. I. 1st Sh. I. 1st Tr. E.	11 39 12 40 13 52 14 51	7 27·4
Fri	26			1st Oc. R.	12 11	7 23·5
Sat	27	21 51 19 3 22	☾ Moon's Last Quarter Near approach of α Scorpii (1½) Conjunction of Moon and Mars 4° 52′ N.	2nd Ec. D.	17 22 58	7 19·5
Sun	28			3rd Ec. D.	17 16 19	7 15·6
MAR. Mon	1	9	Inferior conjunction of Mercury and Sun	2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	12 28 14 26 14 59 16 51	7 11·7

THE PLANETS FOR FEBRUARY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	21 48 38	S. 14 46	5"·4	1 3·3
	9th	22 36 46	S. 8 53	6"·1	1 19·9
	17th	23 4 59	S. 3 52	7"·9	1 16·6
	25th	22 58 51	S. 2 43	9"·7	0 39·0
Venus ...	1st	17 49 33	S. 19 1½	30"·0	21 1·0
	9th	18 20 17	S. 19 30½	27"·1	21 0·2
	17th	18 53 31	S. 19 38½	24"·6	21 1·9
	25th	19 28 31	S. 19 19	22"·6	21 5·3
Mars ...	1st	15 29 29	S. 17 54½	7"·5	18 41·3
	9th	15 47 37	S. 18 59½	7"·9	18 27·9
	17th	16 5 31	S. 19 57	8"·4	18 14·3
	25th	16 23 8	S. 20 47½	8"·9	18 0·4
Jupiter ...	1st	13 58 51	S. 10 41½	35"·7	17 10·9
	9th	13 59 46	S. 10 45	36"·7	16 40·4
	17th	13 59 56	S. 10 44	37"·5	16 9·1
	25th	13 59 21	S. 10 39	38"·5	15 37·0
Uranus ...	2nd	9 3·41	N. 17 32	4"·2	12 12·6
	14th	9 1 36	N. 17 41	4"·2	11 23·4
Neptune ...	2nd	1 47 16	N. 9 13	...	4 57·4
	14th	1 48 3	N. 9 18	...	4 10·9

Mercury may be seen for about an hour after the sun at the beginning of the month, the interval increasing to 1h. 46m. on the 14th; after which he sets nearer to the sun each day.

Venus may be observed three hours before sunrise at the beginning of the month, the interval decreasing.

Mars will be visible at two hours and a quarter after midnight, at the beginning of the month, the interval gradually decreasing.

Jupiter is well situated for observation, rising at midnight on the 1st day, and afterwards earlier each night. On the 28th he rises at half-past 10 o'clock p.m.

Uranus is well situated for observation, and will be in opposition to the sun on Feb. 2.

EPHEMERIS OF WINNECKE'S COMET.

1875. February.		R.A. h. m. s.		Decl. ° ′		Light.
1	...	17 41 7	...	−15 26	...	0·49
3	...	17 52 8	...	15 41		
5	...	18 3 18	...	15 54	...	0·53
7	...	18 14 35	...	16 6		
9	...	18 25 59	...	16 15	...	0·58
11	...	18 37 29	...	16 22		
13	...	18 49 3	...	16 27	...	0·62
15	...	19 0 39	...	16 29		
17	...	19 12 18	...	16 29	...	0·66
19	...	19 23 58	...	16 26		
21	...	19 35 37	...	16 21	...	0·69
23	...	19 47 14	...	16 14		
25	...	19 58 49	...	16 4	...	0·71
27	...	20 10 19	...	15 52		
March 1	...	20 21 45	...	15 38	...	0·72

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat. of the centre of the sun's disc.	Angle of position of sun's axis.	
	°	°	°	°	°
Feb. 1	31·33	+13·18	—6·16	347·55	—0·40
2	44·51	·18	6·23	347·15	·40
3	57·69	·19	6·29	346·75	·40
4	70·88	·18	6·36	346·35	·40
5	84·06	·18	6·42	345·95	·39
6	97·24	·18	6·48	345·56	·38
7	110·42	+13·18	—6·53	345·18	— ·38
8	123·60	·19	6·59	344·80	·37
9	136·79	·18	6·63	344·43	·36
10	149·97	·18	6·69	344·07	·36
11	163·15	·18	6·74	343·71	·36
12	176·33	·19	6·78	343·35	·35
13	189·52	·18	6·83	343·00	·35
14	202·70	+13·19	—6·87	342·65	— ·34
15	215·89	·18	6·91	342·31	·33
16	229·07	·18	6·95	341·98	·33
17	242·25	·19	6·98	341·65	·32
18	255·44	·19	7·02	341·33	·31
19	268·53	·18	7·05	341·02	·31
20	281·81	·19	7·08	340·71	·31
21	295·00	+13·18	—7·10	340·40	— ·30
22	308·18	·19	7·13	340.10	·29
23	321·37	·19	7·15	339·81	·28
24	334·56	·18	7·17	339·53	·28
25	347·74	·19	7·19	339·25	·28
26	0·93	·19	7·20	338·97	·27
27	14·12	·19	7·22	338·70	·26
28	27·31	+13·19	—7·23	338·44	— ·25
Mar. 1	40·50	·19	7·24	338·19	·25
2	53·69		7·24	337·94	

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF JUPITER.

1875.	Western longit. of meridian turned to the Earth. at 12h.	Western longit. of meridian turned to the Earth. at 16h.	Angle of posit. of ♃'s axis. at 12h.	Annual parallax. at 12h.	Latitude of Earth above ♃'s equator.	Latitude of Sun above ♃'s equator.
	°		°		°	°
Feb. 15	166·98	312·09	21·38	—9·45	—3·18	—2·82
16	317·65	102·76	·39	9·37	·18	2·82
17	108·33	253·44	·39	9·29	·18	·83
18	259·01	44·12	·40	9·20	·18	·83
19	49·69	194·80	·40	9·11	·19	·83
20	200·38	345·49	·40	9·02	·19	·83
21	351·07	136·19	·41	8·92	·20	·83
22	141·76	286·88	·41	8·82	·20	·84

23	292·45	77·57	·42	8·72	·20	·84
24	83·45	228·27	·43	8·62	·21	·84
25	233·85	18·97	·44	8·51	·21	·84
26	24·55	169·67	·44	8·40	·21	·84
27	175·25	320·37	·45	8·29	·22	·85
28	325·96	111·08	·46	8·17	·22	·85
Mar. 1	116·66	261·78	·47	8·05	·22	·85
2	267·37	52·49	21·48	—7·93	—3·22	— ·85

Increase of longitude in 4 hours, 145·°11 or 145·°12.

The "annual parallax" is the difference of longitude of Sun and Earth, as seen from Jupiter, and reckoned in the plane of his equator. A.M.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1874.
Barneby, T.
Crowe, Rev. R.
Cundell, G. S.
Darby, Rev. W. A.
De la Rue, W.
Dobie, W. M.
Freeman, G. T.
Glaisher, J.
Green, G. W.
Hedgeland, J. W.
Jackson, T.
Kershaw, A. E.
Lee, A.
Watson, J.
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Yeates, Miss.

To March, 1875.
Ambruster, C.
Baron, Rev. J.
Burham, S. W.
Cook, J.
Elliott, R.
Hemming, Rev. B. F.
Jackson-Gwilt, Mrs. H.
Rivaz, Miss.
Wright, Rev. W. H.

To April, 1875.
Prince, C. L.

To June, 1875.
Buffham, T. H.
Dearden, W.
Glover, E.
Jefferies, J.
Jenkinson, Rev. J. H.
Lance, G. A.
Main, Rev. R
Metcalfe, Rev. W.
Noble, Captain.

To July, 1875.
Young, L. S.

To Dec., 1875.
Backhouse, T. W.
Baldelli, Contessa.
Barber, J. T.
Bird, F.
Clermont, Lord.
Collingwood, E. J.
Davies, Rev. R. P.
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Johnson, R. C.
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L ttsom, W. G.
Monk, Dr.
Parnell, J.
Redpath, H. S.
Rogers, W.
Rogerson, G. R.
Schafarik, Professor.
Smyth, Piazzi.
Tidmarsh, J. B.
Vernon, G. V.
Walker, G. J.
Williams, G.
Wilson, T.

To Dec., 1876.
Potter, Rev. R. J.
Roberson, C.
Warner, T.

TO CORRESPONDENTS.

We are obliged to postpone Reviews and several interesting articles through want of space.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications, Letters, Articles for insertion, &c., must be sent to the Rev. J. C. Jackson. Hackney Collegiate School, *Clarence Road*, *Clapton*, *E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 147. MARCH. 1875.

ROYAL ASTRONOMICAL SOCIETY.

Session 1874—75.

Fifty-fifth Anniversary Meeting, February 12th, 1875.

Professor Adams, F.R.S., *President*, in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

The minutes of the last anniversary meeting were read and confirmed.

The following candidates for the Fellowship of the Society were balloted for and duly elected:

W. H. Thornthwaite, 3, Holborn Viaduct, E.C.

Prof. W. D. Niven, M.A., Fellow of Trinity College, Woolwich Common, S.E.

Jelinger Edward Symons, Lieut. R.N., 6, Berners Street, Oxford Street, W.

Nathaniel E. Green, Artist, 3, Circus Road, St. John's Wood.

E. W. Maunder, Royal Observatory, Greenwich.

William Hammond Cole, M.A., Deputy Superintendent G. Trigl. Survey of India, Dehra, N. W. P. India, or care of Rev. E. Cole, M.A., Gr. Plumstead, Norwich.

M. José Gonzalez, 6, Cité Rougemont, Paris.

Selections from the Report of the Council to the Annual General Meeting of the Society were read.

It was stated that there are 554 fellows and 45 associates of the Society. Ten fellows have been expelled during the past year, and 42 elected, 5 have been removed from the lists by deaths, leaving a total increase of 27.

Obituary notices were read of Professors Hansen, Mädler, Pontécoulant and Quetelet, deceased associates of the Society, of Mr. Burr, Lieut. Carpendale, and Mr. Cox deceased Fellows, and of Mr. Williams, the late assistant secretary.

The Report contained the usual notices of the year's work at

the principal observatories, public and private, and a resumé of the transit of Venus observations, with an account of the telegraphic determination of the longitude of the Egyptian stations, and the Council's report on the Astronomical work of the past year, which is somewhat longer than usual. Eight minor planets have been discovered, and five telescopic comets, besides the great comet of M. Coggia. Active progress has been made in meteoric astronomy. The following subjects were also noticed :—M. Cornu's redetermination of the velocity of light ; M. Struve's interesting observations of ζ Cancri and the companion of Procyon ; Mr. Todhunter's history of the theories of attraction and figures of the earth ; Mr. Stone's observations of the eclipse of April 16, 1874, in South Africa, and the Belgian observations on the scintillation of coloured stars ; Le Verrier's planetary researches ; the periodic errors in the right ascensions of standard stars ; and the periodicity of the sun's diameter. At the termination of the reading of the Report,

The Astronomer-Royal said : Will you allow me, Mr. President, to make two remarks which have been suggested to me by the Report. The first is with regard to the biography of Hansen. If I caught rightly what was said, no mention was made of the present to him by the British Government. When his tables were completed, the Board of Visitors of the Royal Observatory, Greenwich, thought it right to make a representation to the Government as to the value of these tables, and the House of Commons voted that a reward of £1000 should be given to Professor Hansen. I think, sir, it was an honour to both parties, and I am anxious the fact should not be passed over in the Report.

Mr. Dunkin : I will see that it is inserted.

The Astronomer-Royal : The next point to which I wish to invite your attention was suggested by the mention of the property of the Society. It is said that there are instruments belonging to this Society which have been lent out and have never been returned, nor can any equivalent be obtained for them. Now this is a matter which I think ought to be looked to, not only for its own sake, but also for the sake of the general credit of the connections between persons who make observations in distant stations and the Society. It has had this effect upon me, that a short time since when application was made to me, either on my own responsibility or by recommendation to the Government, to lend some instruments for a scientific expedition, I declared positively that I would not do so unless I had the formal personal guarantee of some responsible gentleman. This is the state to which we are driven by such instances as that to

which I refer. I think it is very desirable that the transactions between other persons and this Society should be quite understood, and set right.

Mr. Bidder: I do not know whether I may be allowed to make one or two observations, but it occurred to me, during the reading of the Report, that while we cannot help feeling that it is admirably put together, and the obituary notices extremely well given, yet there are many parts which we should appreciate a great deal better if we read them quietly in our own homes; and if we had only a short abstract read at these meetings we should save a great deal of time and enjoy the full Report more afterwards at home. I know that to many of us time is valuable, and I saw that some of the senior members of the Society were trying to economise time by snatching short, fitful repose. The other matter that caught my ear, as it did that of the Astronomer-Royal, and certainly somewhat astonished me, was that we had lent instruments of which no account could be given. I should like to echo the Astronomer-Royal's observations, but it also occurs to me that if the British Association is the body to whom those instruments have been lent, there cannot be any difficulty whatever in getting from such a great scientific Society an account of instruments lent to them. Certainly, speaking as an outsider, it appears to be a circumstance that requires further explanation. It cannot for a moment be permitted that instruments, the property of the Society, should be permanently annexed by another Society or an individual. Therefore, I think we ought to have some further explanation in the matter There is only one other point I would refer to. I heard some reference to a catalogue that has been printed, and in which, according to Mr. Dunkin's reading of the Report, there were neither distances nor position-angles given of the double stars which were catalogued. Now, knowing nothing of the catalogue myself, it strikes me *primâ facie*, that a catalogue of double stars, containing neither distance nor position-angle, must be of extremely small utility. It may have some great value which is peculiar to itself, but unless that be so I trust that not much of the Society's money has been expended in its publication.

Captain Noble: The Astronomer-Royal has only anticipated me in reference to that little sentence in our Report, for I think I am bound to say I have learned something to-day which the whole Society ought to know, as it is absolutely monstrous. If I am credibly informed, the instruments which we lent to the British Association, for the observation of the eclipse of 1871, have been made a present to Mr. Ellery, in Australia. Now, speaking

as a magistrate, I have had occasion to put in force an Act which states, that if anybody shall be a bailee of the chattel of another person, and shall fraudulently convert such chattel to his own use, he shall be "so and so"—I do not wish to use hard words, but I say it is absolutely monstrous that property of this Society should be obtained for a specific scientific purpose, and then be made a present by the recipient to a man who has no lien upon it, and could not hold it against us for five seconds.

Mr. Bidder: Who did it?

Capt. Noble: I could say a good deal about the instruments and the whole affair, but I prefer confining myself to a bare statement of facts. I say if this be the case somebody must be hanged; somebody is legally responsible for it, and I should be glad to elicit such an expression of opinion from the Society as would fortify the Council in their attempt to recover either the instruments or their money value.

Mr. Bidder: If the facts referred to are correct, it seems to me the remedy is extremely simple. If the British Association has given to Mr. Ellery that which is ours, it is still ours, and if it is not restored we can only bring an action against Mr. Ellery.

Admiral Ommanney: I presume after what has been said an official communication will be made to the British Association. I have the honour of being a member of the Council, and will bring the matter before their notice.

Capt. Noble: Several communications have been made.

Admiral Ommanney: I beg leave to move that an official communication be made to the British Association.

Mr. Dunkin: In the first place I would make a remark with regard to what Mr. Bidder said about drawing up abstracts of the obituary notices and the report for reading at our meetings. I can assure him if he had had the trouble of preparing such a report once he would not care about also making an abstract. The preparation is a very laborious task, and once is quite enough for me. With regard to the loan of the instruments to the British Association Eclipse Committee, the question is really a very important one. It appears that two years ago a correspondence took place between myself, as Secretary of the Astronomical Society, and the Secretary of the British Association. I pointed out that it was high time that the instruments should be returned to this Society. The answer I obtained was, that the Secretary of the British Association knew nothing about it: that the instruments were lent to an Eclipse Committee, which was totally distinct from the British Association Council; and that that Committee had acted entirely on their own responsibility. No explanation could be given as to what had been done with the instruments,

except that the Secretary of the British Association remarked that he did not know what had become of them, but that he would apply to the Secretary of the Committee.

A Fellow: Was it a Committee of the British Association?

Mr. Dunkin: Yes, with full power to act. About a month or two after that, a letter was sent to me from the Secretary of the British Association, asking me if I thought the Council of this Society would agree to present these instruments to the Melbourne Observatory, provided an equivalent was given to this Society. I replied that the Council was not sitting, but I thought that if the Committee presented instruments of a similar kind to this Society, then our Council perhaps would have no objection; but, of course, I told them I could not give them authority to do so, and they must wait until the matter was considered by the Council. I heard no more about it till lately, when accidentally I saw a printed report for the year 1873 from Mr. Ellery, and also a report for 1874. It seems a long time to refer back to 1873, but it appears that the two reports were sent to England together. The report for 1873 is stitched up with that for 1874. Now, in that report there is a paragraph in which Mr. Ellery thanks the British Association Committee for having presented to them certain instruments, of which there is a list given. In that list are our instruments. It is stated in the report that Mr. Lockyer, as the secretary of the Committee, presented the instruments, and that the Melbourne astronomers asked the Government to send a special vote of thanks to Mr. Lockyer for having made the present. Then, of course, the matter came officially before me. I felt that, as the Secretary of this Society, it was my duty to lay the case before the Council, and it was resolved that an official application should be sent to the British Association Council. Acting upon that, I have sent the official application, or, at least, I have drawn the attention of the Council of the British Association to this paragraph in the report, and have asked them to inform me, on behalf of the Astronomical Society, under what circumstances our instruments were delivered to Mr. Ellery and the Melbourne Observatory. I have not received an answer yet, though that was three or four weeks ago; but I received a private letter yesterday from Mr. Griffiths, saying that he knows nothing about it, as this business was entirely in in the hands of Mr. Lockyer, but he will send me a formal answer in a few days.

Mr. De la Rue: After the explanation given by Mr. Dunkin, I cannot but think that Captain Noble has made use of some,—I might almost say, ill-considered remarks. It does appear that the British Association has made the offer to give an equivalent

in value for the instruments, which one of its committees has, through an error or some misapprehension, made a present of, in its zeal to promote science, but the British Association, as an honourable body of scientific men, when informed of the circumstance, offered to take upon itself the responsibility of the act of its committee, and to make restitution of similar instruments or of an equivalent amount. I really think that the expressions which have fallen from Captain Noble are scarcely warranted.

Mr. Bidder: I do not understand that the British Association has made any offer.

Mr. Dunkin: Yes, the Secretary of the British Association corresponded with me two years ago on the subject.

Mr. Bidder: It is essential that we should know the exact facts. If I understand aright, before the instruments were given to Mr. Ellery, a communication was made asking whether the Council would be willing to allow them to be presented to him, and Mr. Dunkin, whilst stating that he had no authority to bind the Council, expressed his belief that if equivalent instruments were given, the Council would be willing to allow them to be given up. Then I understand that no further communications passed between the two Societies. The instruments were subsequently given, without the knowledge or assent of the Council, and from that day to this there has been no word or promise of restitution or equivalent.

Mr. Browning: Will you allow me to say that I think it is highly undesirable that the instruments of the Society should be given away at all. It is well known to the members that the instruments of the Society are almost exclusively presents from various persons, who undoubtedly wish that those instruments should remain in the possession of the Society. The knowledge that a number of instruments have been presented to any one else, would certainly have the effect in future of checking such liberality, and I think that such gifts are very desirable.

Captain Noble: I merely wish to ask whether the application to which Mr. Dunkin referred was ever before the Council?

Mr. Dunkin: It was not.

Captain Noble: We knew nothing about it?

Mr. Dunkin: It was merely a private letter addressed to me in my private capacity, not as secretary, and of course I gave a private opinion.

Mr. De la Rue: What are the instruments? Are they of such a character that they cannot be replaced?

Mr. Dunkin: They are modern instruments that can be replaced.

Mr. De la Rue: I quite agree with Mr. Browning that no

instruments of the Society ought to be given; at the same time, if these are instruments that can be replaced, and the British Association are willing to replace them, the matter may soon be put right.

Mr. Dunkin: In 1870 a joint committee was formed; the Royal Society made a grant towards the expenses of that committee, and this Society made an equal grant; and according to a resolution of this joint committee, the instruments, when returned to England, were to become the property of the Astronomical Society. Those instruments were purchased with the grant, and therefore they are modern instruments. They consist of a polarimeter, two five-prism spectroscopes, and some other small matters that were procured for the eclipse of 1870. Then, in 1871, the eclipse coming so soon after, they were transferred for the purposes of that expedition.

A Fellow: May I ask the value of the instruments?

Mr. Ranyard: About £25 at the outside.

The President: This discussion has gone on now sufficiently long. I think we quite understand the nature of the case. There is no doubt that a mistake has been committed. The instruments have been given by those to whom they did not belong, but I have no doubt whatever when the matter is explained the mistake will be corrected; and I do not think we need show any strong feeling about it, provided the mistake is rectified.

The President then delivered his address on the gift of the medal to Dr. D'Arrest for his Catalogue of Nebulæ and other astronomical works.

Admiral Ommanney: I rise to submit a resolution for your acceptance. You have just heard the report of the Council read, and I feel that it must be a source of satisfaction for us all to find that the Society is augmenting in its number of Fellows, and that its sphere of action is expanding throughout the country, and I am sure you have also heard with very great edification the learned address of our distinguished President. It is impossible for me to dwell upon the merits of this able and comprehensive composition, but, in erudition, I believe it is second to none of the productions of his great mind. I beg leave to move this resolution:—"That the Report now read be received and adopted, and be printed and circulated in the usual manner, together with the President's address."

Mr. Mattieu Williams seconded the resolution, and the motion was unanimously carried.

Admiral Ommanney inquired if the Council intended to make any alteration in the arrangement of the rooms of the house. He considered too many rooms were appropriated to the Assistant-

Secretary, he felt sure that the Government in making over the building to the Society had never intended that such handsome rooms should be occupied by the secretary.

Prof. Pritchard also thought the accommodation provided for the Assistant-Secretary inordinate, and said that he was sorry he could not induce the Council to think with him on the subject.

Mr. Dunkin said the rooms occupied by the Assistant-Secretary were only those which were marked on the original plan as intended for that purpose.

Mr. Ranyard said the Society was not able to give a large remuneration to its Assistant-Secretary, and if some such inducement as good lodgings was not offered, men of the requisite ability would not accept the post.

Mr. Huggins said that the wish on the part of some of the Fellows for a room for conversation might be met by placing seats in the instrument room, which is on the same floor as the library.

Mr. De la Rue proposed and Mr. Brewin seconded a vote of thanks to Mr. Dunkin for the manner in which he had looked after the arrangements and furnishing of the different rooms. The proposal having been agreed to, Mr. Dunkin acknowledged the compliment. The House list of Officers and Council was elected by a large majority, and the proceedings closed with a vote of thanks to the President, Vice-President, Officers, and Members of the Council for the past year. The list for the new year stands:—

President.

J. C. Adams, Esq., M.A., F.R.S., Lowndean Professor of Astronomy, Cambridge.

Vice-Presidents.

Arthur Cayley, Esq., M.A., F.R.S., Sadlerian Professor of Geometry, Cambridge.
Warren De la Rue, Esq., D.C.L., F.R.S.
William Lassell, Esq., LL.D., F.R.S.
Lord Lindsay, M.P.

Treasurer.

Samuel Charles Whitbread, Esq., F.R.S.

Secretaries.

Edwin Dunkin, Esq.
A. Cowper Ranyard, Esq., M.A.

Foreign Secretary.

William Huggins, Esq., D.C.L., LL.D., F.R.S.

Council.

Captain William de W. Abney, R.E.
Sir G. B. Airy, K.C.B., LL.D., F.R.S., &c., Astronomer-Royal.

Sir Edmund Beckett, Bart., LL.D., Q.C.
W. H. Mahoney Christie, Esq., M.A.
J. W. Lee Glaisher, Esq., M.A.
George Knott, Esq.
Rev. Robert Main, M.A., F.R.S. Radcliffe Observer.
Captain William Noble.
Rev. S. J. Perry, F.R.S.
Rev. Charles Pritchard, M.A., F.R.S., Savilian Professor of Astronomy, Oxford.
Captain G. L. Tupman, R.M.A.
J. Maurice Wilson, Esq., M.A.

Erratum.—Owing to the loss or miscarriage of a letter, the Editor of our reports of the Astronomical Society's meetings failed to receive the following erratum in time for last month's number. Mr. Lassell's remark on page 42 should run thus:—With equal areas, that is to say, the annulus being equal to the disc, you would get the best definition from the disc and the greater separation from the annulus.

THE TRANSIT OF VENUS.

Sir,—I am very glad to be able to report to you, and to astronomers generally, that a communication has been forwarded to me by Mr. Stone, her Majesty's astronomer at the Cape, in which he states that very satisfactory observations of the time of egress of Venus were made at the Royal Observatory, Cape Town, at the late transit, by himself and by his assistants, Mr. Finlay and Mr. Maclear. Mr. Stone remarks that there is no doubt whatever of the ligament, or black drop, having been seen by him continuously from his first recorded time, 19h. 7m. 12·05s., Cape mean time. Several sketches of the various appearances of the ligament at short intervals of time have also been forwarded, which will be exhibited at the next meeting of the Royal Astronomical Society.—I am, sir, yours truly,

Royal Astronomical Society, Burlington House, London W., Feb. 13.

EDWIN DUNKIN, Hon. Sec. Royal Astronomical Society.

In reply to which the following letter appeared in *The Times*:

Sir,—In order to estimate the real significance of the news published in *The Times* of to-day by my friend Mr. Dunkin, your readers should be informed that the observation of egress at Cape Town has no special value. The valuable egress regions were those near New Zealand for egress accelerated, and those around the Caspian sea, as far as Egypt, Persia, and North India, for

egress retarded. Cape Town is somewhat remote from either region, unless my geography fails me. Cape Town had real value as a mid-transit station for photographic or heliometric work. It would be as useless now to inquire why no provision was made for either kind of work as to inquire why Mr. Stone, Astronomer-Royal at the Cape, was provided with no suitable means for observing the important total eclipse of April, 1874. But though past opportunities cannot be recalled, a useful lesson may be learnt as to the future.

Mr. Stone's observation of the "ligament" or "black drop," is curious. An eminent continental astronomer recently remarked to Professor Newcomb, chief of the Washington Observatory, now visiting Europe, that only unpractised observers had on this occasion seen the "black drop" as Mr. Stone's theory of the Transit of 1769 required—that is, for 20sec. or so. It is rather a singular illustration of the effect of preconceived ideas that Mr. Stone himself, who is, I understand, a very skilful observer, should not only have seen the ligament, but have actually succeeded in sketching its "various appearances" at short intervals of time. Lord Lindsay's party agree that all the phenomena of the "black drop" "took place and disappeared in a period of 5 sec."; but then they had on theory to maintain. RICHARD A. PROCTOR.

THE TRANSIT OF VENUS.

(*Continued from page* 48.)

Mr. Proctor pointed out, some time ago, the great value of photographs taken at the Cape of Good Hope in combination with those secured at Nertschinsk and Roorkee. We have no information that any photographs were taken at the Royal Observatory at Cape Town, but a correspondent informs us that 14 successful photographs were taken at Cape Town, two of them showing distinctly the black drop.

With regard to the observations made by Lord Lindsay's party at the Mauritius, Lord Crawford has been good enough to forward to us the following extracts from letters he has just received from Lord Lindsay and Mr. Gill.

Lord Lindsay writes :—

"I am happy to say that I have been very fairly successful in the observation of the transit. We lost all the first half of the time from dense clouds, but towards the end of the day it was fine. I took altogether about 260 photographs, of which I think I shall get 70 or 80 of great value. Mr. Gill has five complete sets of observations, and Dr. Copeland seven, so on the whole we have done well. . . . I cannot tell you how pleased I am with my men here, the crew. I could not possibly have done one-third of what I have done without them. They are all so interested and willing that it is a pleasure to work with them. I made the most complete organization of the stations and division of labour for every man, and drilled each separately, and then altogether, and I never had a single mistake during the whole time."

Mr. Gill writes :—

"It is impossible for me to describe the pleasure which it gives me to

tell you of the success of Lord Lindsay's expedition. Not particularly favoured in point of weather (for during the first hour of the transit the sun was entirely obscured, and afterwards partly hid at intervals by passing clouds), a result has been obtained which I feel sure is second to none. Dr. Copeland and myself have both been successful; but it is the photographic determination which, I believe, will be found to give the most wonderful results. There is one picture, and most fortunately it is one of the finest, which shows the phenomenon of last internal contact of the planet with the sun's limb. Now this internal contact and its accompanying phenomena have been a matter of dispute and discussion ever since the last transit. But here is a picture which, as an astronomical record, is invaluable; for, automatically, the instant of its exposure has been recorded in the revolving barrel, and is preserved there for future reference, fixed by a machinery and a method which cannot err."

The Astronomer-Royal forwards to us the following telegram, which he has received from Rodriguez:—"Aden, January 21. Ingress and egress well observed from three stations in Rodriguez; nine Janssen plates; fifty-eight sun pictures. Observers—Neate, Hoggan, and Wharton."—*Times.*

Dr. W. Huggins, F.R.S, delivered a lecture last night at the London Institution on the Transit of Venus, which he explained with the aid of diagrams and the magic lantern. He showed a black disc moving over a light one and drawing after it (as it appeared) the dark band which constitutes the "black drop," and he exhibited large photographic pictures of the sun and its corona. The object of the recent observations was, said Dr. Huggins, to determine the distance of the sun from the earth, and he began by describing several ways of ascertaining the mathematical facts about objects which we cannot approach. By computing the parallax—that is, by observing the difference of position which the object has when viewed from different standpoints—as at Greenwich and the Cape of Good Hope, for example—we know the distance of the moon within 20 or 30 miles of its actual distance. Why cannot we apply this simple method to the sun? One great drawback is that the angle to be measured in the one case of the sun is only about 1-400th as large as the angle to be measured in the case of the moon. But, also, we live at the bottom of an ocean of air, and we have to look at the heavenly bodies through this air, and we see them all displaced from their true positions. Any small variation in the temperature or density of the air alters its refracting power. The case of the sun is more than ordinarily unfavourable, because of the disturbing influence which its heat has upon the air, and if we were to attempt to measure its parallax directly it would be uncertain from this one cause of refraction alone to about one-third of the total amount. In the case of the moon the difference can be eliminated by comparing it with a star quite close to it, and the stars are so distant from us that they suffer little from the bending power of the air. It was suggested long ago that it would be possible from the distance of the moon to ascertain the distance of the sun. But unfortunately the moon is rough, and in consequence it is not possible to tell exactly when it is half illuminated. Kepler suggested that we might take the distance of Mars, for when we know the distance of one object in the solar system we can by a system of ratios find the others. Mars comes nearest the earth every 18 years. An observer at Greenwich would measure the distance of Mars from some small star near it. An observer at the Cape would measure the distance of Mars from the same star, and the difference between these measured distances would show the small apparent shift of position of Mars due to

its being viewed from two different stations. In this way an exceedingly trustworthy determination of the sun's distance has been obtained. It was calculated in 1862 by Mr. Stone to be 91,240,000 miles. About a year ago, Dr. Galle, of Breslau, showed that advantage might be taken of the next opposition of Flora, a small planet between the orbits of Mars and Jupiter, when she would be at a distance from the earth of less than nine-tenths of the sun's distance from the earth. In consequence of this suggestion, Flora was observed at nine stations in the northern part of the earth, and three in the south, and the distance of the sun deduced is 92,000,000 miles. Another method is to avail ourselves of the perturbations of the moon. One of the perturbations depends upon the sun's distance from the earth. In her passage round the earth it is clear that at one point the moon is nearer to the sun than the earth is, and consequently the sun pulls the moon more strongly. By a careful examination of 2,000 observations of the moon, Mr. Stone has by this method deduced a distance of the sun from the earth of 91,200,000 miles. There is another method founded on lunar perturbations, and Leverrier suggested that if we can find the mass of the earth by an independent method, then from that value we can find the distance of the sun. The earth produces inequalities in the motion of the two planets Venus and Mars, and by observing the amount of these inequalities Leverrier determines the mass of the earth independently, and thence infers a solar distance of 92,110,000 miles. The velocity of light, 185,300 miles per second, is used in two ways. The time which the movements of Jupiter's moons take in reaching us across our whole orbit is 16 minutes, and half the diameter of our orbit will be the distance from its central point, the sun. There is another way. The artillerist directs his gun in front of a moving ship, and just in the same way a telescope has to be planted in advance of a star. It is found that the inclination which must be given to a telescope is 20 seconds of arc. The earth travels in its orbit 18½ miles every second. If we know how many miles the earth goes over every second, we know the length of the circumference of its orbit, and from the circumference we calculate the radius by a well-known formula. About 500,000 miles remained in dispute as the result of these methods, and therefore so much interest was taken in attempting to fix it by the transit of Venus. This is a rather roundabout way of finding the distance of the sun. We know the proportion of the distance of the earth from the sun to the distance of Venus from the sun. We also know the angular measure of the diameter of the sun. If you know the number of seconds in a small arc, you know how many times that arc will be repeated in the length of the radius. But we only know these proportions; we do not know the actual distance of the sun in miles. One way of looking at the transit of Venus is this—that by means of noticing the position of the black spot traversing the face of the sun from stations on the North and South of the earth we see the shift of its position upon the sun, and so can measure a certain distance upon the sun in miles, and can say that a certain part of the sun's diameter measures so many miles. Thus we get the whole diameter in miles, and then we have only to multiply this by certain known proportions, and we get the sun's distance. The transits occur either singly or in pairs, at an interval of from 105½ to 122½ years. In the recent transit, to an observer in the south Venus seemed to go across a shorter chord, and across a longer chord to an observer in the North. This transit lasted 4½ hours, and Halley's method was to watch it all through. But Delisle suggested to record at two stations either the beginning of the transit (ingress) or the ending (egress). The method of Delisle demands, unfortunately, an accurate knowledge of the

longitude of the stations. To determine longitude with scientific exactitude we must find out at one station precisely what o'clock it is at another of which the longitude is known. If you can see signals or communicate by cable there is no difficulty, but for distant places recourse must be had to chronometers or the moon. Quite recently Mr. Gill, Lord Lindsay's assistant, by going backwards and forwards with a batch of some 45 chronometers, found the comparative longitudes of Mauritius and Rodriguez. But we must rely upon the moon for such distant places at the Sandwich Islands and Kerguelen's Land. The moon moves among the stars like the hand of a clock passing through the figures of a dial, and the observer can tell that when she reaches a certain star it will be such a time at Greenwich. Dr. Huggins would not speak of the results of the observations, for they had been fully reported in the newspapers, but as to the methods. First, there were eye observations; next, photographic records of the positions of Venus upon the sun; and there might be observations by the eye aided by the spectroscope. By the aid of the spectroscope means had been devised, with which one or two of the expeditions were supplied of observing Venus before she actually reached the sun, and so being ready for the moment of contact. At the critical moment a curious phenomenon comes in. As Venus comes within the limit of the sun she seems to cling to him; portions of the black sky outside the sun and portions of the black rim of the planet seem to adhere together, and to be drawn out as if Venus were made of indiarubber, and you have in this way a black patch formed between the two. As you watch this black drop it becomes thinner until it is reduced to a thin line, and then it suddenly snaps as a piece of indiarubber might. Part of this appearance is due to the telescope, part to irradiation, and part to some particular relation between the eye and brain of the individual, so that no two observers see exactly the same phenomenon. A very bright object always appears to spread over a neighbouring dark object. The observers in 1761 and 1769 took different phases of the drop phenomenon for the moment of contact, and Encke averaged their observations at 95.000,000 miles, the old incorrect statement of the distance of the earth from the Sun which we have all learnt. A few years since Mr. Stone re-discussed the whole matter, and by carefully studying the exact words of the different observers he was able to attribute to each observer the particular phase of the black drop which he took for the moment of contact, he thus made the observations coincide, and returned the result at about 91,500,000 miles. Dr. Huggins described the horizontal telescopes, 40 feet long, with a mirror in front of the object glass, which are used by the American parties, and the Janssen rotatory photographing apparatus. Unfortunately, by the mistake of an operator the Janssen machine in Egypt had been set to work too soon, and the 60 photographs were taken before Venus was quite in the right place. Colonel Tennant was not quite successful in India, either, in the use of this apparatus. But it was hoped by calculation to make the pictures which had been taken serviceable. The lecture, during the course of which the hall had frequently been in darkness, was concluded by an exhibition of photographs of the sun.

REVIEWS.

The Transit of Venus. A discourse by C. Ragoonatha Chary, F.R.A.S., First Assistant Madras Observatory, Madras.

This little pamphlet, we learn from the author in the preface, "is written principally for the information of such of my countrymen as have not had

the advantage of any regular course of scientific reading. My apology for writing it is that, although the class of phenomena to which the Transit of Venus belongs is mentioned in Hindu treatises on astronomy, especially the Sidhanta Siromani, yet the Sidhantis or Hindu astronomers are really not familiar with the nature of this particular occurrence, and cannot predict it with even a rough approach to accuracy, happening as it does at such strange and rare intervals. They can compute Thithis (one-thirtieth part of the time the moon takes to move through a synodical revolution), Nakshathras (lunar mansions of one-twenty-seventh part of circumference of the ecliptic), &c., for a Punchangum (a Hindu calendar), and can predict ordinary solar and lunar eclipses. Under these circumstances I may be excused for hoping my simple account will be found interesting to native astronomers, and not unacceptable also to general readers of other than the native community. Having been accustomed for many years to discuss astronomical facts and methods verbally with Hindu professors of the art, my present sketch has naturally, as it were, taken the form of a dialogue; but in the Sanscrit, Canavese, Malayalum, and Maharathi versions I have found it convenient to vary the arrangement.

"The sketch was first drafted in Tamil, and then translated into English and the other languages. My sincere thanks are due to my immediate superior, N. R. Pogson, Esq., F.R.A.S., the Government Astronomer at Madras, for his kind scrutiny of the piece, and for his kind recommendation of it to the government of Fort St. George; and also to the gentlemen named in the margin,* for their aid in making translations into the various languages in which I am publishing.

"It might not be out of place to mention here that I am engaged in writing a treatise (to be styled Jyothisha Chinthamany), containing rules, formulæ, and tables based on the English methods of calculation for the guidance of our Sidhantis. As the cost of publication will overtax my very slender means, a number of influential native gentlemen met at Pacheappah's Hall some months ago to consider what means should be adopted to obtain the necessary funds, as well as to establish an observatory, to serve as a school for the instruction of Hindu students desirous to qualify in practical astronomy. On that occasion an address (the substance of which is appended to this pamphlet in a slightly modified form) was read by me. A society was formed, of which the Honourable V. Ramienger, C.S.I., was elected President * * * and other well-known gentlemen became members. I earnestly commend this movement to all native noblemen and wealthy gentlemen in this Presidency, as well as throughout India, who are interested in the improvement of their fellow countrymen, and beg them to join heartily in a design which aims at promoting a most fascinating branch of knowledge, the cultivation of which, although under besetting difficulties and imperfections, is now and always has been highly prized by Hindus throughout the country." * * *

We wish all success to this praiseworthy attempt to make the grand phenomena of the Transit of Venus intelligible in itself, and its use to the native Indian public; and we also hope the author's plans for promoting astronomy among Hindus may obtain the pecuniary aid (not being considerable) on which their success depends. Another time we may perhaps give some extracts from the address above alluded to. In a letter from Mr. Ragoonatha Chary, who has been employed in the

* Mr. C. Nagogi Row, B.A.; Mr. C. Tiruvencatachaviar, B.A., B.L.; Mr. A. Sooba Rao, B.A.; Mr. Mahadéva Muvaswava Kuntay, B.A. (Poona); Mr. Ganesh J. Agash (Poona.)

Madras Observatory since Mr. Taylor's time, who was Director of it: he says, "The instruments we now use are superior to those we then had. They are a transit circle (telescope 5 inches aperture), and two equatorials of 8½ and 6¼ inches aperture. Mr. Pogson is mostly engaged in taking observations of variable stars, and in determining the places of minor planets with the equatorials; and I and other assistants are engaged in determining with the transit instrument the places of unknown stars in the southern regions, for the formation of a star catalogue."

Report of the Meteorological Committee of the Royal Society, for the year ending 31st December, 1873. Printed by G. E. Eyre and W. Spottiswoode for Her Majesty's Stationery Office. 1874. Price 4d.

Particulars of the advance of 1. Ocean meteorology, 2. Weather telegraphy, 3. Land meteorology of the British Islands, will be found in this little pamphlet, which likewise contains a summary of the proceedings of the Meteorological Congress in 1873. We need not give extracts, as all interested should procure the pamphlet, and they will no doubt share our appreciation of the gratuitous and valuable labours of the committee, and of the skill and judgment with which Mr. R. H. Scott, the director, and Captain H Toynbee, the marine superintendent of the office, conduct its important and multifarious duties. The perusal of the report leaves the conviction that progress in this intricate department is being surely made, and it is likely in a few years to be still more marked.

An Elementary Exposition of the Doctrines of Energy. By D. D. Heath, M.A., formerly Fellow of Trinity College, Cambridge. Longmans, 1874. [Price, 4s. 6d.]

The author observes in the preface that the Doctrine of Energy—of its "Conservation" and the "Correlation" of its several kinds—is one that binds together all the Physical and Physiological sciences, by showing that a principle pervades them all which is strictly analagous, perhaps identical, with a long-known proposition in Dynamics. After an introductory section, there follow: Mass and Force—Laws of Motion—Measurement of Heat—Measurement of Work done. The next division treats of Dynamical Energy, including Energy of Motion, direct and oblique—Connected Systems—Impact of perfectly elastic bodies—Varying Forces—Energy of Position, or Potential Energy. Then we come to Thermal and other Energies—Impact, Friction, and Heat. And then follow in order: Change of Physical Condition, &c.—Chemical Energy—Animal Energy—Energy of Vegetation. And lastly, Dissipation of Energies. And the concluding part is upon Molecular Theories.

A tolerably careful reading leads us to praise this little book highly. It requires but a slight acquaintance with algebra and trigonometry, and much of it not even that. We think it will be found an excellent introduction to more extended works on the subjects treated. Perhaps the latter and more difficult half might be a little enlarged with advantage; and an index is desirable. We hope the large circulation which it deserves may not be lessened by its price, which seems to us (in a commercial view) rather high. From the section on Dissipation of Energy, we extract the following:

"Whatever may be the truth about the sun—whether its energy is now replenishing from other sources or not—a consideration of the actual course of nature, in the light of our doctrine of Energy, will tend to show that there is a general tendency to the conversion of all potential energy—dynamical and chemical—into actual or kinetic energy, either motion or

heat; and that this tendency must continue, and produce effects, until all collisions and slidings or rollings between the surfaces of masses having different velocities, and all differences of temperature, and all opportunities for chemical action shall have ceased. * * * There is, therefore, no contradiction between the two statements, that energy is never destroyed (or, more correctly, that when any particular energy disappears it leaves an equivalent behind it), and that a time must come when there will be no opportunities for changes of energy to take place. Let, us, then, look at what is now going on, and to what it is tending. (1) If there is such a thing as sensible motion in a perfect vacuum—if, for instance, there is *no matter* between the boundaries of our solar system and the so-called fixed stars—the motion of the sun and stars, moving in accordance with the law of gravitation in ever-varying curves, if they never impinge on one another, may go on for ever. But if it be true, as there is good reason for believing, that the propagation of light from star to star requires a *material fluid medium*, in which vibrations or *waves* can travel (as waves of sound in air), then this motion of the stars must be diminishing. The medium may have the propriety of *perfect elasticity*, so that no motion is converted into heat (p. 55); nevertheless, the stars, continually altering their velocities by their mutual attractions, will be continually agitating the medium, and parting with some of their motion to it; and the final result would be to allow gravity, to bring all the masses together into one, which would then come to rest, or move in unison with the surrounding medium. (2). Wherever there is impact or sliding between masses not perfectly elastic and perfectly smooth, there will be not only passage from sensible motion of the masses, as wholes, into vibratory motion (sensible or not, according to the range of action) in their interior, or communicated to surrounding bodies, but also expenditure and disappearance of dynamical energy, and corresponding production of heat, (p. 71, &c.). So that the final result of impacts and contacts, in the actual universe (we confine our thoughts to any *finite* portion of it, however large), must be to reduce the motion of all bodies coming in contact to uniformity; with disappearance, on the whole, of kinetic energy, and the raising the general temperature of everything in the space we are considering. Could that space be made impervious to the passage of heat, the raised temperature would remain as a monument of the kinetic energy that had disappeared. But, as this is impossible, the heat, though at no stage diminished in actual quantity, diffuses itself further and further, is *dissipated*, and becomes insensible in any limited space. * * * Thus then, we see that in every portion of the universe, however wide a range we give it, dissipation of energy—not expenditure with no return, but the production of a state in which no further expenditure can take place for want of differences and opposition —is the rule" pp. 110-113.

The Transit of Venus; its meaning and use. By T. H. Budd, F.R.A.S (pp. 20).

An attempt to make the general principle of the phenomena intelligible to persons unacquainted with astronomy. It may, perhaps, answer this purpose, although we think it rather dear at a shilling.

Berthon's Models of Transit of Venus. Horne and Thornthwaite.

The models before us have been devised by the Rev. E. L. Berthon, so well known to the scientific world by his numerous and most useful

inventions, from Dynamometers to Life Boats. Their object is to enable anybody, who has a leisure hour at his disposal, to thoroughly understand the two methods of observation pursued by astronomers at the late transit of Venus.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE MOON A DEAD WORLD.

The following passage occurs in the account of "A Balloon Journey with the French Aeronauts," published in the *Daily News*, Tuesday, September 15, 1874:—

"The white highways that ran like threads among the fields, and the tiny openings in the towns and villages, which we guessed were streets, seemed to belong to a dead world, for nowhere was there the trace of a living person." . . . Sounds were heard, and once a number of horses were seen scampering about, they appeared as if they were pheasants, and a flock of sheep huddled together presented the appearance of a heap of limestone chippings."

If, when looking vertically upon the earth at a distance considerably less than a mile, the appearance of living creatures is exceedingly rare, is it not hopeless to expect to find any indications of life on the moon, except through the medium of the variation of tints? "The fields," beneath the aeronauts, "stretched out in wide expanse, seemed to form a gigantic carpet, shaded from bright emerald to russet brown."

W. R. BIRT

STAR MAGNITUDES.

Sir,—The following stars may possibly be variable :—

ν Orionis, marked 4th magnitude in Mr. Proctor's large atlas, is now about equal to ξ and μ 5th magnitude.

There is a star south of ι Eridani (roughly R.A., 2h. 35m. S. 43½°) marked 6th magnitude by Proctor, which is now about equal to e (4th magnitude), and rather brighter than ν Phœnicis (between β and γ) 4th. magnitude in Proctor, but now more like 5th magnitude.

The star μ Leporis (south of Rigel) though marked 5th magnitude in Proctor's Atlas, and also in Keith Johnston's Atlas of Astronomy, is now distinctly *brighter* than λ Leporis (4th magnitude.) If this star was ever observed of the 5th magnitude, it must, I think, be a variable, as it is now fully of the 4th magnitude, and very little inferior to β. The fact of its being lettered *after* γ would seem to show that it was *fainter* than that star in 1603, when Bayer published his star maps.

A little south of 15 and μ Piscis Australis are two small stars of about mag. 5½, not marked in Mr. Proctor's atlas. They are now very visible to the naked eye, and are decidedly brighter than the 6m. stars between β and ε.

Chambers (descriptive Astronomy, p. 492) mentions that "6 stars near Piscis Australis" have disappeared since Ptolemy's time, so that probably some of the stars in this constellation are variable.

Punjab, India : Your obedient servant,
January 11, 1875. J. E. GORE, A.I.C.E.

STAR MAGNITUDES IN ERIDANUS.

Sir,—There is a 6th mag. star shown by Proctor, a little *north, preceding* v^1 Eridani. This is now quite invisible to the naked eye, and of about the 8th mag. Its position is, roughly, R.A. IIIh. 32m. S 36° 36′.

A little south of v^2 Eridani, Proctor and Keith Johnston show a double star of the 5th mag. This is now about equal to v^2 Eridani, marked a small 3rd mag. by Proctor. It is called *f* Eridani by Webb in his list of "Southern doubles in Celestial objects." Appendix III.

Punjab, India: Your obedient servant,
January 19, 1875. J. E. GORE, A.I.C.E.

SPOTS ON RAINBOWS.

Mr. Editor,—Two rainbows were visible here this morning, parallel to the horizon. Both were brightest towards the sun; the upper one quite bright, with red edge towards the sun, and the lower faint and passing through the sun. Two bright spots were on the lower bow, apparently intersections of a third bow around the sun, with green edge towards the sun. Another faint spot was at a greater distance from the sun. In the two days previous we registered 1-inch of rain, continued cloudiness, and a heavy fog, which settled at 4 p.m. January 27th. The clouds broke at 8.30 a.m., January 29th, and lay around the horizon.

The following measurements were made :—

Sun, shining brightly 20° altitude, 319° azimuth (from South).
Upper bow 64° "
Spots in lower bow 20° " 198° 293° 344°
Local time of maximum effect 9.20 a.m. $\frac{1}{2}$975. Duration 45m.

I am sir, yours respectfully,
J. BURKITT WEBB, C.E.,
In charge of School of C. Engineering.

Meteorological Observatory of Illinois Industrial University:
January 29, 1875.

Extract from *Meteorological Record:*
Standard instruments made by James Green, New York City.

Date. Jan. 1875.		Barometer cor. for temp. &c.	Temperature Air, Fahr.	Minimum Thermometer	Force of Vapour.	Relative Humidity.	Clouds.	Wind.
28	6.30 p.m.	29·126	28·6		·105	·677	10	N. 5m. p.hr
29	9.40 a.m.	29·542	24·4	19·2	·060	·454	4 cir.	N.W. 4 "
29	2·30 p.m.	29·058	30·1		.094	·552	4 cir.	N.W. 3 "
29	6·30 p.m.	29·115	28·8		·071	·450	10	S.W. 7 "

Latitude and Longitude about 40° N., and 5h. 55m. W. Greenwich.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MARCH, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXI. British Association map, 50° to 55 N. latitude.

Thirty-two and a half degrees from the moon's western limb Endymion (27) the southern part (*a*) 32°, Miss Mitchell (430), Aristotles (78) the northern part (*b*), Mare Frigoris (*c*) stretches from the 42nd Meridian to the north-west extremity of the wedge-shaped valley (*c*). The Alps (80),

Plato (132) the northern part. Mrs. Jackson Gwilt (438) (*d*) 13°, Condamine (137) 6°, Bouguer (142) 4°, Foucault (475) 3°, Harpalus (133) Sinus Roris (*r*) 15° from the moon's eastern limb, Repsold (167) (*e*).

(*a*) References to Endymion are as follows:—Webb's Celestial Objects, third edition, p. 85. B. and M.'s 'Der Mond,' p. 205, § 181. Schröter's Fragments, vol. 1, p. 650, § 519, T. XLII.

(*b*) Schröter's delineation of Eudoxus and Aristoteles will be found in his T. XIII. His G. on the west of Aristoteles is Miss Mitchell. His description of these and neighbouring objects is contained in the first volume of his Fragments, pp. 217 to 228 §§ 151 to 157.

(*c*) See B. and M.'s "Der Mond," p. 214, § 194.

(*d*) The reader will find on p. 20 of the Second Issue of "Selections from the Portfolios of the Editor of the Lunar Map and Catalogue," two drawings of this crater; one by Schröter as he observed it on the 9th of October, 1788, and one by the Editor of the "Selections" as seen by him on December 29th, 1873. These drawings are accompanied by notes of the appearance and character of the crater.

(*e*) Between Harpalus and Repsold and 17° eastwards of Harpalus, is an unnamed crater, rather smaller than Harpalus, but considerably larger than Foucault. It is not on Webb's Index Map, but is certainly a conspicuous object on B. and M.'s. It does not appear to have been, at any time, since B. and M.'s epoch an object of study.

This zone contains but few striking objects, nevertheless the student may find in it material for good work, especially on Plato. Webb mentions that in some states of libration the large walled plain Endymion is very dark in full. Here then is a fine object to study in connection with Plato.

The discontinuance of the ephemeris for physical observations of the moon cannot be regarded otherwise than with regret. It must have been very discouraging to the computer to find month after month no observations quoted for the elucidation of which the ephemeris would have been valuable for fixing the epochs of the conditions of certain features, the extent and disappearance of shadows for example, and also for the variation in tint of certain spots. One almost seems to despair of selenography being efficiently studied. While other branches of astronomy have attracted, and are still attracting, great attention, that devoted to a critical examination of the moon's surface with the view of becoming better acquainted with its features is greatly neglected. On what does this neglect depend?

The *Register* embracing as it does so wide a scope, but few of its pages can be available for selenographical notices of current observations. A large mass of material, in the shape of drawings, etc., has been collected during the last fifteen years, of which a small portion only has been given to the public. It is to be hoped that the remainder will, in some way, be rescued from being ultimately lost. The non-publication of Schmidt's map, and the fact that the best works on selenography are available to German students only, are indications of the very restricted interest manifested for lunar studies.

DISCOVERY OF A NEW PLANET (141).

By Monsieur Paul Henry in Paris.

(Bulletin International, No. 14.)

1875, January 13th, at 12h. 47m. mean time, Paris.

R. A., 10h. 34m. 34s., P. 82° 30′ 27″.

Hourly motion in R. A. = — 1s.25, P. = + 4″·2, magnitude 12·5.

The planet being at present a considerable distance from opposition its increase in brilliancy will be rapid.

ASTRONOMICAL OCCURRENCES FOR MARCH, 1875.

DATE.		Principal Occurrences. h. m.		Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
						Procyon
Mon	1		Sidereal Time at Mean Noon, 22h. 35m. 31·90s.	2nd Sh. I.	12 28	—
		9	Inferior conjunction of Mercury and Sun	2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	14 16 14 59 16 51	8 55·8
Tues	2	2	Conjunction of Mars and ω Ophiuchi (7·7m.) W. Saturn's Ring: Major axis=34″·74 Minor axis=8″·26			8 51·9
Wed	3	15	Conjunction of Moon and Venus, 7° 21′ N.	2nd Oc. R. 1st Ec. D.	10 58 16 26 24	8 47·9
Thur	4		Sun's Meridian Passage 11m. 57·93s. after Mean Noon	3rd Oc. D. 3rd Tr. E. 1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	10 52 12 38 13 32 14 27 15 45 16 38	8 44·0
Fri	5	9	Conjunction of Moon and Saturn, 3° 41′ N.	1st Ec. D. 1st Oc. R.	10 54 47 13 58	8 40·1
Sat	6		Conjunction of Moon and Mercury, 7° 16′ N.	1st Sh. E. 1st Tr. E.	10 13 11 5	8 36·1
Sun	7	8 20	● New Moon			8 32·2
Mon	8			2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	15 2 16 47 17 33	8 28·2
Tues	9					8 24·3
Wed	10			2nd Oc. R. 1st Ec. D.	13 18 18 19	8 20·4
Thur	11	6 3 7 8	Occultation of 40 Arietis (6) Reappearance of ditto	3rd Sh. I. 3rd Sh. E. 1st Tr. I. 3rd Tr. E. 1st Tr. I.	10 52 13 15 15 26 16 6 16 4	8 16·5
Fri	12	10 43	Near approach of 33 Tauri (6)	1st Ec. D. 1st Oc. R.	12 48 9 15 44	Moon. 4 16·5
Sat	13			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	9 54 10 40 12 7 12 57	5 15·6
Sun	14	1 5 6 44	☽ Moon's First Quarter Near approach of 136 Tauri (5)	1st Oc. R.	10 11	6 16·7
Mon	15	13 31 14 22	Occultation of 47 Geminorum (6) Reappearance of ditto Illuminated portion of disc of Venus=0·615 Illuminated portion of disc of Mars=0·891	2nd Sh. I.	17 36	7 17·6

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Moon.
Tues	16	8 28 9 44 9 30 9 59	Occultation of ω^1 Cancri (6) Reappearance of ditto Occultation of ω^2 Cancri (6) Reappearance of ditto			8 15·9
Wed	17		Sidereal Time at Mean Noon 23h. 38m. 36·76s.	2nd Ec. D. 2nd Oc. R.	11 49 25 15 38	9 10·3
Thur	18		Sun's Meridian Passage 8m. 16·97s. after Mean Noon	3rd Sh, I. 3rd Sh. E. 1st Sh. I.	14 50 17 12 17 19	10 0·2
Fri	19	16 2	Near approach of *l* Leonis (5)	2nd Sh. E. 2nd Tr. E. 1st Ec. D.	9 24 10 38 14 41 34	10 46·1
Sat	20			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 48 12 26 14 1 14 37	11 29·1
Sun	21	11 51	○ Full Moon	1st Ec. D. 1st Oc. R.	9 9 55 11 56	12 10·1
Mon	22		Saturn's Ring: Major axis=35″·30 Minor axis=7″·85	1st Tr. E. 3rd Oc. R.	9 3 9 26	Regulus — 10 1·8
Tues	23	23	Conjunction of Moon and Jupiter, 2° 55′ N.			9 57·8
Wed	24			2nd Ec. D.	14 24 31	9 53·9
Thur	25					9 49·9
Fri	26	19	Conjunction of Saturn and Venus 1° 16′ N.	2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E. 2nd Ec. D.	9 26 10 30 11 58 12 54 16 35 4	9 46·0
Sat	27			1st Sh. I. 1st Tr. I, 1st Sh. E. 1st Tr. E.	13 41 14 10 15 54 16 21	9 42·1
Sun	28	7	Conjunction of Moon and Mars 5° 2′ N.	1st Ec. D. 1st Oc. R.	11 3 26 13 40	9 38·2
Mon	29	16 24	☾ Moon's Last Quarter	3rd Ec. D. 1st Sh. E. 1st Tr. E. 3rd Oc. R.	9 74 2 10 23 10 48 12 47	9 34·2
Tues	30			1st Oc. R.	8 6	9 30·3
Wed	31			2nd Ec. D.	16 59 53	9 26·4
APRIL Thur	1					9 22·4

THE PLANETS FOR MARCH.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	22 41 30	S. 4 20	10″·6	0 9·7
	9th	22 18 23	S. 8 1½	10″·3	23 7·5
	17th	22 22 24	S. 10 9	8″·7	22 36·5
	25th	22 39 23	S. 9 42	7″·8	22 25·6
Venus ...	1st	19 46 28	S. 18 57½	21″·6	21 7·5
	9th	20 22 50	S. 17 50½	20″·0	21 12·5
	17th	20 59 26	S. 16 12	18″·6	21 17·3
	25th	21 35 55	S. 14 3	17″·7	21 22·3
Mars ...	1st	16 31 48	S. 21 10	9″·1	17 53·3
	9th	16 48 42	S. 21 49½	9″·7	17 38·7
	17th	17 4 56	S. 22 22½	10″·5	17 23·5
	25th	17 20 19	S. 22 50	11″·2	17 7·4
Jupiter ...	1st	13 58 46	S. 10 35	38″·9	15 20·7
	9th	13 57 3	S. 10 24	39″·6	14 47·6
	17th	13 54 41	S. 10 9½	40″·3	14 13·7
	25th	13 51 44	S. 9 52	40″·9	13 39·3
Uranus ...	2nd	8 59 3	N. 17 51½	4″·2	10 17·9
	18th	8 57 1	N. 17 59½	4″·2	9 13·0

Mercury is not well situated for observation, his greatest distance from the sun being on the 16th, when he rises 45m. before the sun.

Venus may be observed two hours before sunrise at the beginning of the month, the interval decreasing to an hour and a quarter at the end of the month.

Mars is visible one hour and three quarters after midnight, at the beginning of the month, the interval slightly decreasing.

Jupiter is well situated for observation, rising soon after 10 p.m. on the 1st. On the last day he rises at 8 p.m.

Uranus may be well observed.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat. of the centre of the sun's disc.	Angle of position of sun's axis.	
	°	°	°	°	°
Mar. 1	40·50	13·19	−7·24	338·19	−0·25
2	53·69	·19	7·24	337·94	·24
3	66·88	·19	7·25	337·70	·24
4	80·07	·19	7·25	337·46	·23
5	93·26	·19	7·25	337·23	·22
6	106·45	·19	7·25	337·01	·22
7	119·64	13·19	−7·24	336·79	− ·21
8	132·83	·20	7·24	336·58	·20
9	146·03	·19	7·23	336·38	·19
10	159·22	·19	7·22	336·19	·19
11	172·41	·20	7·20	336·00	·19
12	185·61	·19	7·19	335·81	·17
13	198·80	·20	7·17	335·64	·17

14	212·00	13·20	—7·15	335·47	— ·16
15	225·20	·19	7·13	335·31	·16
16	238·39	·20	7·10	335·15	·15
17	251·59	·20	7·08	335·00	·14
18	264·79	·20	7·05	334·86	·14
19	277·99	·20	7·02	334·72	·13
20	291·19	·20	6·99	334·59	·12
21	304·39	13·20	—6·95	334·47	— ·11
22	317·59	·21	6·91	334·36	·11
23	330·80	·20	6·87	334·25	·10
24	344·00	·20	6·83	334·15	·09
25	357·20	·21	6·79	334·06	·09
26	10·41	·20	6·75	333·97	·08
27	23·61	·21	6·70	333·89	·07
28	36·82	13·21	—6·65	333·82	— ·06
29	50·03	·21	6·60	333·76	·06
30	63·24	·20	6·55	333·70	0·5
31	76·44	·21	6·49	333·65	0·4
April 1	89·65		—6·43	333·61	

Assumed daily rate of rotation 14°·20. A.M.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF JUPITER.

Greenwich Midnight. 1875.	Longit. of meridian turned to the Earth.		Angle of posit. of ♃'s axis.	Annual parallax.	Latitude of Earth above ♃'s equator.	Latitude of Sun above ♃'s equator.
	°	°	°	°	°	°
Mar. 1	116·7	870·7	21·47	— 8·05	—3·22	—2·85
2	267·4	·7	·48	—7·93	·22	·85
3	58·1	·7	·49	7·80	·22	·85
4	208·8	·7	·50	7·67	·23	·86
5	359·5	·7	·51	7·54	·23	·86
6	150·2	·8	·53	7·41	·23	·86
7	301·0	·7	21·54	—7·27	—3·23	—2·86
8	91·7	·7	·56	7·13	·23	·86
9	242·4	·7	·57	6·99	·24	·86
10	33·1	·8	·59	6·84	·24	·86
11	183·9	·7	·60	6·69	·24	·86
12	334·6	·7	·61	6·54	·24	·86
13	125·3	·7	·63	6·39	·24	·86
14	276·0	·8	21·65	—6·23	—3·24	—2·87
15	66·8	·7	·67	6·07		·87
16	217·5	·7	·69	5·91		·87
17	8·2	·8	·71	5·75		·87
18	159·0	·7	·73	5·59		·87
19	309·7	·8	·75	5·42		·88
20	100·5	·7	·77	5·25		·88
21	251·2	·7	21·79	—5·08	—3·24	—2·88
22	41·9	·8	·81	4·90		·88
23	192·7	·7	·83	4·72		·88
24	343·4	·7	·86	4·54		·89
25	134·1	·8	·88	4·36		·89
26	285·9	·7	·90	4·18		·89
27	75·6	·8	·92	4·00		·89

	28	226·4	·7	21·95	—3·81	—3·24	—2·89
	29	17·1	·7	21·98	3·62		
	30	167·8	·8	22·00	3·43		
	31	318·6	870·7	22·03	3·24		
April	1	109·3		22·05	3·05	—3·24	—2·89

To find the long. of the central meridian, add to the long. given in the ephemeris—

h. m.		°	h. m.		°
At 12 0	G.M.T.	0·0	At 14 0	G.M.T.	72·6
10		6·0	10		78·6
20		12·1	20		84·7
30		18·1	30		90·7
40		24·2	40		96·7
50		30·2	50		102·8
13 0		36·3	15 0		108·8
10		42·3	10		114·9
20		48·4	20		120·9
30		54·4	30		127·0
40		60·5	40		133·0
50		66·5	50		139·1
14 0		72·6	16 0		145·1

A.M.

Book received.—"Prophetic Astronomy." By R. Sheward. Charing Cross Publishing Company. 1874.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1874.

Benson, Rev. R. W.
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To June, 1875.

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To Dec., 1876.

Slugg, J. T.

To Dec., 1877.

Lawrence, E.

TO CORRESPONDENTS.

We are obliged to postpone Reviews and several interesting articles through want of space.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps, but the Editor will not be liable for loss in transmission.

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The pages of the *Astronomical Register* are open to all suitable communications, Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON. Hackney Collegiate School, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 148. APRIL. 1875.

ARGELANDER.

There is scarce a science whose advancement has not been promoted in the countries around the Baltic; and in astronomy we need not be reminded of what we owe to the great observer of Uranibourg, and to the more illustrious Prusso-Polish priest of Thorn. The astronomical genius of the North has been strikingly developed in our own day; but some of its most celebrated men have been lost to us within a very limited period. Not many years have elapsed since the elder Struve ended his distinguished life. It is not one year since Angström, eminent in many branches of science, passed away in the full vigour of his intellect, and we have now to record the loss of Argelander.

Friedrich Wilhelm August Argelander, born at Memel, March 22, 1799, died at Bonn on the 17th of last February, at 6 A.M., so that he had nearly completed his 76th year.

He studied under Bessel at Königsberg, graduated there at the University in 1822, and in 1825 was made director of the Observatory at Abo. Here he first attracted general notice by his investigation of the orbit of the comet of 1811, for which he found a period of 3065 years; and here also he seems to have first turned his attention to the proper motions of the stars, our own sun, as he concluded, being one of those that moved the most rapidly through space.

The great fire at Abo, in 1827, destroyed the University buildings, including the Observatory; and in 1832 Argelander was translated to Helsingfors, the new capital of Finland, to inspect the building of an observatory and assume its directorship. Pursuing his observations of stars with proper motions, he here completed a catalogue of 560 of those bodies, which gained for him the Demidoff prize at the academy of St. Petersburg.

In 1837 he came to Bonn, where he superintended the erection of the new observatory; and, meanwhile, in a temporary structure on one of the river bastions, called the "*Alter Zoll*," he began his studies of variables as well as his important northern zone observations, in which he was assisted by Herr Kysäus. He removed to the new building in 1845, and laboured chiefly at the meridian circle, though he still attended to the variables and to comet observations when opportunity offered. Schmidt became his assistant in 1846, when he was employed on the star maps of the Berlin Academy.

For the observations connected with the maps the comet seeker in the west tower was used with a micrometer-scale on glass, devised by Argelander. On this scale the differences in declination could be seen without artificial light, and a second observer at the clock noted the right ascension. An observation extended to 68 minutes, and 1° in declination. Schmidt and Argelander used to take their station at the telescope and the clock by turns. Argelander at the telescope used to observe in 68 minutes from 200 to 300 stars, and Schmidt from 500 to 600. This great difference was caused by Schmidt's noting even the smallest objects, a proceeding not approved of by Argelander, who feared confusion in taking in such a multitude of stars. Schmidt, however, maintained that the correctness of the positions would not be impaired by the number, and continued to note down everything that he could observe distinctly. Argelander soon left the management of these observations to Schmidt, who completed hour V, the map of which is distinguished among the series for its richness in objects; and it is due to Schmidt to say that he it was who, in this work, proved the feasibility of Argelander's subsequent and greatest performance, the *Durchmusterung*. This immense undertaking was begun towards the close of 1852; and, Schmidt having left early in 1853, it was prosecuted and completed in ten years, with the assistance of Schönfeld and Krüger.

In the midst of his gigantic labours in the observatory, Argelander found time to give lectures both there and at the university. It is unnecessary to transcribe a list of the numerous and well-known works that have raised him to imperishable

fame, and to which the astronomical observer of the present, and every future age will refer with admiration and gratitude. His genius seemed in a remarkable degree to influence his pupils, of whom no less than four, in widely separated parts of Europe, now occupy distinguished places as directors of observatories. Schmidt is director at Athens, Schönfeld at Mannheim, Krüger at Helsingfors, and Förster at Berlin. The readers of the *Register* and the *Astronomische Nachrichten* are well acquainted with Dr. Schmidt's untiring zeal in every department of his profession. His great lunar map, the result of 35 years' unassisted labour, is now nearly ready for publication; and, judging by one section of it that has been shown in this country, we may say that it must stand an unrivalled monument of human industry and skill.

Argelander leaves a widow; and, out of a family of six, only two sons and one daughter are living. The youngest daughter, who was married to Dr. Wolf, died not long since. The eldest is the wife of Krüger.

ROYAL ASTRONOMICAL SOCIETY.

Session 1875—76.

First Meeting of the New Session, March 12th, 1875.

Professor Adams, F.R.S., *President*, in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

The minutes of the last meeting were read and confirmed.

Mr. Ranyard reported that 67 presents had been received by the Society since the February meeting. The thanks of the Society were formally voted to the donors.

The following candidates for the Fellowship of the Society were balloted for and duly elected:

Major-General J. C. Hannyngton, India Office, S.W.

H. Savile W. Evans, Esq., Wimbledon Park House.

Arthur M. W. Downing, Esq., B.A., Assistant Royal Observatory, Greenwich.

John Dreyer, M.A., University of Copenhagen.

Professor Robert Stawell Ball, F.R.S., M.R.I.A., Professor of Astronomy in the University of Dublin, and Royal Astronomer of Ireland.

Mr. Dunkin said he had a paper from Mr. Stone, of the Cape of Good Hope, *On the total eclipse of the sun of April* 16, 1874. It was a long and elaborate paper, and would be printed in a volume of the Memoirs. There were also a series of sketches of

the appearance of the corona made at two stations, some 500 miles away from one another; the drawings of the two series were very similar, and were particularly interesting, as having been made by persons working independently of each other, and knowing very little of astronomy. Mr. Dunkin then read a few extracts from the paper, first with respect to the existence of additional absorption lines in the sun's spectrum, near the moon's limb, as seen upon the sun during the partial phase. The slit of the spectroscope was placed radially upon the moon's limb, and the spectrum was examined with care, but Mr. Stone could not detect any additional lines or change in the appearance of Fraunhofer lines. He therefore considered that this observation afforded another proof that there does not exist any sensible atmosphere round the moon, and that no sensible refraction of the sun's light can take place.

As the time of totality approached the sun's limb was brought upon the slit; the field of the spectroscope appeared to be full of bright lines of different lengths. His impression was that the Fraunhofer lines were seen reversed, but this was only an impression. He could only with certainty state that a very large number of bright lines were seen. The greatest portion, however, quickly vanished, and he then saw little more than the hydrogen spectrum. The appearance, as seen with the naked eye, was that the corona consisted of a pink-coloured irregular ring—that the prominences appeared rose-coloured, of a deeper red than the inner corona. When looking for the parts beyond the inner corona he saw most distinctly, and without difficulty, the branches of the outer corona, as marked in the diagrams which were exhibited at the meeting.

While the telescope was directed to the middle of the corona the spectrum was examined. He could only distinguish one bright line, and if there were any other lines they were much fainter; but, besides the one bright line, there were distinct absorption lines, although they were only seen with great difficulty; but on moving the telescope towards the extreme limb of the broad branch this line, which at first was seen extending across the slit, gradually became fainter, till at last he lost sight of it from extreme faintness. Mr. Stone's paper concluded with a summary of the results obtained from the observations.

Mr. Ranyard said: One of most interesting points in the paper is that the inner corona has been observed again as something separate from the outer corona, as was the case in the 1870 eclipse, but it will be remembered by those who are conversant with the photographs of the various eclipses that in the 1871, the 1869, and the 1851 corona photographs there is no distinct

inner corona. In Mr. Brothers' photograph of the 1870 eclipse there was a well marked boundary, at which the intensity of the light of the corona rapidly diminishes, and outside that boundary there is an extensive field of light which has been spoken of as the outer corona. This inner and outer corona appears to have been observed again; but the corona of last April would seem to have been more symmetrical with regard to the sun's axis than that of 1870. In its symmetry it seems to have been more like the coronas of 1871, 1869, 1860, and 1851. On the other hand the corona of 1870 was not very symmetrical, as seen in the photographs. The great southern rift was considerably to the east of the sun's axis, and in fact there is very little symmetry to be recognised; but the 1870 drawings give the corona as much more symmetrical; many of them give a quadrilateral corona, and in some of Mr. Stone's drawings the quadrilateral form is again well marked.

Mr. Brett: Does this appear in the corona as seen with the eye in a photograph, because the greater part of the corona being yellow would not be in the photograph at all?

Mr. Ranyard: The drawings made in 1871, for example, by Captain Tupm n, Mr. Halliday, and many others, agree with the photographs very well as to the chief features, and as to the great rifts.

Mr. Neison: There is one point I should like to ask; what could Mr. Stone have expected to find in the moon's atmosphere? If the moon's atmosphere is the same as the earth's it would be impossible to get any new absorption lines in the spectroscope, for the amount of air at the moon's limb would be at the most one-tenth of what must be passed through on the earth's surface before reaching the observer.

Mr. Ranyard: Professor Young in 1869 watched the lines up to the moon's limb, and found no additional absorption lines or any observable change. Mr. Neison probably knows that when the sun is high there are no absorption lines, or rather none that we know to be absorption bands, but the ray that passes along the moon's limb would have to pass through a length of atmosphere corresponding to double the course of a ray from the sun on our horizon.

Mr. Neison: But at the utmost it could not be possible to exceed one-tenth of what it would have to undergo in passing through the earth's atmosphere; therefore you could not get any new lines.

Captain Noble: I do not know whether Mr. Neison observed the last occultation of Saturn by the moon. I did; I saw every scrap of detail of Saturn up to the very limb of the moon. I

am perfectly certain that an atmosphere of the faintest appreciable density must have caused something like distortion. The definition was peculiarly good, and I saw the whole of the detail of Saturn's rings, the delicate markings on the ball, &c., up to the moon's limb, as though the moon were cut out of tin.

Mr. Dunkin: I can corroborate Captain Noble. I made an observation of the occultation of Saturn, and I noticed that the definition of Saturn was remarkably clear up to the moon's limb, and there was not the slightest diminution of the light of Saturn, nothing to show that there was anything like an atmosphere.

Mr. Dunkin said he had a paper from Professor Ellery, of the observatory of Melbourne, *On the transit of Venus*. It appeared that Mr. Ellery had obtained a very extensive collection of observations from the several stations. One was from a station near Melbourne, and another from Mornington, under the late Professor Wilson, a very distinguished man in the colony, who has recently died, the excitement of the transit had, it appeared, so greatly affected him, that it caused his death a few days afterwards. But it should be said that he was in ill-health at the time, and had been engaged preparing for examination at the university. The paper, therefore, had a melancholy interest, for it was the last thing that he had done.

The President: I have had a letter from a friend of his, giving me an account of his death. Professor Wilson was very much interested in the transit, and, at Professor Ellery's request, observed it at one of the out stations. He made good observations, and occupied the whole of the next day in writing the report which we have before us this evening. He was engaged in very hard work at the same time, and had a university examination to attend to. I understand that he got up the next morning and worked for three hours before breakfast at his examination papers, but immediately after breakfast a blood-vessel broke on his brain, and he died in the course of the day.

Mr. Dunkin: Professor Wilson was a very distinguished man, a senior wrangler, and a fellow of St. John's.

The President: He was at Belfast before he went to Melbourne, and interested himself very much there in the cause of astronomy; he induced them to build an observatory, for which he obtained the old mural circle, I believe, from Kew Observatory.

Mr. Dunkin: A number of years ago Professor Wilson came to the Royal Observatory, and it was my duty to explain to him some of the details of the work; I remember that I was very much impressed with his general knowledge, and the interest he took in astronomy. The instrument which went to Belfast Observatory was, I believe, not from Kew, but from the Royal

Observatory; it was the old mural circle—Jones's circle. It was sent, at one time, to the Cape of Good Hope, and afterwards it was returned, and was sent to Belfast. I will read some extracts from Professor Ellery's report:—

The extracts read recorded that the weather was at first overcast; there was occasional thunder and lightning, and not a glimpse of the sun was obtainable; when at last there was a slight break in the clouds Venus was well on the sun's limb. The internal contact was watched by Mr. Ellery. The sun was clearly defined, and very steady; the mottling on the sun's surface beautifully distinct. The dark disc of Venus was margined by a fine edge of light. As the time of internal contact approached the cusps of the sun's limb seemed to burst out and embrace one another. A streak of light of a "glimmering" colour then appeared between the planet and the sun's limb, and this gave way to the appearance of a bright band, which further changed into a smoky band that occupied the space between the planet and the sun's limb. This gradually gathered up to a thin thread, and then suddenly disappeared. There was an absence of nearly all of the appearances seen in the artificial transit, and the motion of Venus was so slow that it was impossible to assign the time of internal contact within two or three seconds. The thunder showers had left the atmosphere very clear and still for the observations. Soon after internal contact, measures of the diameter of Venus were commenced. A careful scrutiny for any appearance of atmosphere about Venus was made, but nothing definite was observed. The times of both the ingress and egress were obtained at this station.

Following the paper were a series of observations by Mr. White, assistant of the Melbourne University, and Mr. Gilbert's and Professor Wilson's notes made at Mornington. The latter observed that about five minutes before contact the dark edge of Venus outside the limb of the sun was accompanied by a narrow illuminated arc, which was not a mental continuation of the dark circle of the planet's disc. Shortly before the second internal contact the sky became quite clear, but rather boiling, and the definition was consequently not so good. Venus seemed much smaller, she did not look round, but spherical.

Mr. Dunkin read parts of a paper by Mr. Stone on observations of the transit at the Cape of Good Hope. A detailed description of the appearance of the black drop was given, and a series of drawings of the phenomenon as seen by Mr. Stone were shown to the meeting.

Mr. Dunkin said that he had also a long series of reports from the Sydney Observatory, too long to read. Mr. Russell had made

elaborate preparations at subsidiary stations, with funds from the Colonial Goverment, to the extent of £1,300. The observers were surprised at what they saw, and in one or two cases lost the time of first internal contact in looking for the black drop. At one station 40 photographs were taken; at another none were obtained, owing to wrong focussing of the instruments; at a third 53 pictures and 50 Janssen plates; some of the latter were very interesting, being taken at the time of the formation of the black drop; but there appears no sign of the black drop on the plates. Venus appears in contact with cusps perfectly sharp.

Mr. Tebbutt, of New South Wales, had also sent a short account of the transit. The weather was remarkably favourable. The first perceptible break of the sun's limb was observed, and at the time of first external contact the sun's limb was sharply defined and the observation was an unusually good one. A few minutes after this he was surprised to find that the whole of the limb of Venus which had not entered on the sun's disc was distinctly marked by a margin of greyish light. This halo increased, while no halo or penumbra surrounded the portion of the planet projected on the sun. Shortly before first internal contact the appearance was similar to Mr. Stone's drawings in the *Monthly Notices*, the distance between the cusps being equal to one-fourth of the planet's diameter; but owing to the excitement of the moment no exact time was taken of this phase.

Captain Noble: I have been much struck by the fact that in most of the papers just read the observers speak of the appearance of the dark body of the planet, as projected on the background of the sky (the portion off the sun), as if they had seen something very curious indeed, but I daresay it will be in the recollection of a large number of the Fellows present that in the *Monthly Notices* I have described this as occurring in, I think, nearly every inferior conjunction of Venus during the last 15 years. I have seen the whole body of Venus distinctly projected upon a lighter background of some sort. Everybody who has observed these inferior conjunctions will have seen what appeared like a silver hair of light illuminating the limb; and where the circle is completed the planet appears dark; in fact, it has the same appearance as the old moon in the new moon's arms, only in that case there is a phosphorescence about the old moon which is not seen on Venus.

Mr. Green: Have you seen that when the planet has been farther from the sun than at conjunction?

Captain Noble: No; I have generally watched her in inferior conjunction, sometimes within a few hours of conjunction, and then I have seen the continuation of the limb as dark projected upon an apparently lighter background.

Mr. Ranyard: It has been assumed that Venus has been seen as a dark object upon the brighter background of the corona. I have seen Venus, as Captain Noble describes, in inferior conjunction, and I certainly believed at the time that I saw the unilluminated portion of the disc as a dark patch upon a brighter background, but now I am not sure whether it was really so; possibly what I saw was the illuminated crescent on one side, and on the other or dark limb a hazy line of light, like that observed in the transit observations, round the limb of the planet before it was upon the sun's disc. This would lead the eye round, and possibly give the appearance of the black disc. With very faint light it is difficult to say with certainty whether one area is darker or brighter than another; all you can positively say is that you see something there. It is an important point to determine whether the corona is really bright enough to serve as a background that will throw up a dark object by contrast while our atmosphere remains illuminated. I am disposed to think that it is not bright enough on ordinary occasions, for the limb of the moon has repeatedly been looked for just off the sun's disc during partial solar eclipses, and some very good observers (Dawes and many others) have been unable to detect it. On the other hand, there have been observers who have thought they were able to detect it, but most of them have only traced it for a minute, or two minutes, of arc outside the sun's limb, and that not continually; so that it may possibly on these occasions have been projected upon the background of prominences. This is the only theory upon which I can harmonise the different observations; for my own part, I have only once looked for it, that was during an eclipse, I think, in September last. I was in Florence at the time, and the sky was very clear, but I could not with certainty trace the limb outside the sun; occasionally I thought I saw it, but on throwing the sun outside the field I lost it again. I therefore feel inclined to think that that the corona is not bright enough to serve as a background that will throw up a dark object, and certainly not at a distance of three or four degrees from the sun. The appearance of Venus at inferior conjunction must be due, I imagine, to some line of light along the dark limb; probably to the light of the sun reflected within the planet's atmosphere; in fact, to the light of sunset or of dawn, as the case may be.

Mr. Bidder: I suppose there is little doubt that this bright line round the dark body of Venus is due to the refractive power of the atmosphere of Venus, and I cannot help thinking that if the observations were collated we might get some means of measuring the refractive power of the atmosphere of Venus.

There is another suggestion I would throw out for the consideration of Captain Noble and Mr. Ranyard, with reference to the difference between Venus and the moon with regard to their visibility upon the background of the corona. The very circumstance Captain Noble referred to of the old moon appearing phosphorescent in the new moon's arms may explain the difference between the two cases, and the reason why Venus may be visible although the moon is not. Even at the time of an eclipse the moon has a considerable amount of illumination from the reflection of the earth light, and is not so absolutely black a body as the planet Venus. I do not know what the suggestion may be worth, but it may be worth consideration.

Mr. Christie: What the observers have noticed is not a difference of intensity between Venus and the sky outside, but a bright line round the disc of Venus, and therefore it is not the effect of contrast between the body and the atmosphere, but simply the existence of this bright line marking the boundary.

Mr. Ranyard: Janssen seems to have spoken of it as the disc of Venus projected upon the corona.

Mr. Christie: We have only the authority of a telegraph for that.

Mr. Bidder: This diagram of Mr. Tebbutt's shows that the bright line, if it has any real existence, must be due to the refraction of the sun's light from Venus's atmosphere.

Captain Noble: With respect to what Mr. Ranyard has stated about the moon's limb in the case of partial eclipses, it may be recollected that on two occasions I have seen that for a few seconds of arc. On the first occasion I had a blue eye-cap, and I was then told, as I have said here before, that with blue glass you could see anything. On the second occasion I used red glass, and saw the same thing. Therefore I am absolutely convinced that it is so; and at the time I made these observations they were corroborated by others. I am certain I saw the moon's limb for a few seconds projected. I do not say what it was upon, but it was exterior to the sun's limb. I could see part of the dark moon outside the sun a very little way, but there it was.

Mr. Green: I certainly can corroborate Captain Noble's statement as to that phenomenon. My memory is weak as to the particular eclipse, but about 10 years ago, though I was quite unconscious of what I ought to see, I have a clear remembrance of the dark limb of the moon at a considerable distance from that of the sun. I thought nothing of it at the time, but accounted for it by an illuminated atmosphere surrounding the sun. With regard to the question of Venus near inferior conjunction, and

the dark portion being visible, a friend who was with me saw it upon one occasion, but on passing a dark band in the eye-piece over the illuminated portion of Venus we could see nothing of it. This occurred on another occasion in the day-time. We could, or thought we could, see the light all round, but again, directly the illuminated portion was put behind the dark band, the illusion vanished.

Mr. Neison: As to the moon's being projected beyond the sun, it strikes me that it may be an effect of contrast which gives the idea that you can see the dark moon projected beyond the sun; but I have taken several photographs of the partial phase on which there is not the slightest sign of it to be seen. I think, therefore, that it may not be a real phenomenon.

Mr. Ranyard: Mr. Liais, in describing the photographs of the partial phase of the eclipse in Peru, 1858, says the lunar limb is distinctly visible in one of the photographs outside the sun, but I believe he only saw it in one of them; there was no trace of it in any of the others. It was, therefore, probably an accident, or it may possibly have been that part of the moon's limb was just then projected on a bright prominence.

Mr. Christie: What the observers noticed with the eye does not seem to have been borne out by all the photographs. But in two paper prints from the photographs taken in the Sandwich Islands which have been sent to us the disc of Venus is distinctly to be traced outside the sun's limb, and several of us at Greenwich have examined it carefully, cutting off the sun's limb with a piece of white paper. It may, of course, have been an accidental stain in the paper. It is not safe to draw any conclusions from it now. We must wait till we get the negatives themselves.

Mr. Brett: It is not to be supposed that everything visible to the eye will be visible in a photograph.

Captain Abney was then called upon to read a paper *On the differences between the English and American methods of Photography used in the transit of Venus.*

Captain Abney said: I wish to say a few words on a subject which has exercised the minds of certain contributors to the newspapers who have supposed that the English system of photography is inferior to that of the Americans. Much stress has been laid on the point that you can measure on the photographs taken in the focus of the forty-foot telescope and calculate directly the diameter of the sun and the position of Venus without distortion, but there is no more difficulty in calculating the diameter of the sun in the English heliograph than with the forty-foot telescope. This difficulty being placed on one side, there seems to be very little superiority in the American system, and there are many

drawbacks. Supposing the images to be distorted in both, in the English system the distortion can only arise from the telescope itself, and can be imitated by photographing a scale, and that is what is being done; but distortion in the American system will also arise from the heliostat; and the difficulty of investigating the amount due to the telescope, as well as to the heliostat, will be a difficult matter for investigation. It is also said that irradiation is a drawback in our system, but I think that irradiation is partly caused by the heating of the atmosphere between the instrument and the sun, and experiment after experiment had shown me that radiation proper is really due to the reflection from minute particles on the plate. I know that Mr. Ranyard does not agree with me in this, but it is so. It has been stated that Daguerreotype plates are totally free from radiation, but this is not the case, as can be proved by inspection. A remark made by the Astronomer-Royal has been misunderstood with regard to the Daguerreotype plates. It was said that he considered them far superior to the ordinary collodion plates, but as far as I can understand it was that he preferred the Daguerreotype pictures to the paper prints, and not to the negatives at all. Again, the Daguerreotype plates are much less sensitive, and would be affected by the expansion and contraction, owing to the temperature at the time of exposure. And one great disadvantage of the American system is that there is a body of heated air between the siderostat and object glass, and this alone must cause irradiation.

Mr. Ranyard said he agreed with Captain Abney, possibly a great deal more than Captain Abney supposed. He was fully of the same mind as to the dry-plate process being superior to the Daguerreotype process, chiefly because of the difficulty of estimating the contraction or expansion of the metal plate with temperature; but a point in which he did not agree with Captain Abney was as to the difficulty of determining the distortion due to inequalities in the plane of the siderostat; he did not believe that there was any such distortion, for the effect of a slight imperfection of the plane was to spoil the definition of the instrument, and not to shift the different parts of the image.

Captain Noble read a short paper *On an apparent change in the colour of Uranus.* He said he desired to call the attention of telescopic observers to this planet. For eighteen years he had observed it, and his notes showed that it had always had "a pale blue disc," but on the evening of the 9th of March last he saw the faintest suspicion of yellow on it, the pale blue had certainly vanished. He would be glad to have his observation confirmed or disproved by other people who possessed larger telescopes. It was

now universally admitted that there was a change of tint every few years upon Jupiter, and it was not impossible that Uranus might be subject to the same sort of changes.

Mr. Christie: Did you compare Uranus with any standard light?

Captain Noble: No.

Mr. Christie: Because the tint of Uranus is rather difficult to estimate, being almost a neutral grey. With one eye I see it as a pale red, and with the other as a sea-green, whilst another observer with the same instrument sees it as blue. The effect of contrast operates so wonderfully, that if the light or sky were a little different, and the observer had been looking at a strong light, or a differently coloured object, he might have seen it apparently change in tint. I do not say that that is necessarily the cause, but there is always the suspicion. I have seen the light of the moon, after looking at a bright light of another colour, as a bright green; I would not have believed it possible if I had not seen it. So that we must be cautious how we accept changes of colour.

Captain Noble: I do not think Mr. Christie's explanation will suffice, because, as a matter of fact, Uranus was the first thing I looked at, except a clock star. I was struck with the colour instantly, because I was so familiar with the planet. The disc was anything but blue. I do not know the state of my eye; of course the whole thing may have been subjective, but to my eye it presented a wholly different appearance.

The President: Did you try it with both eyes.

Captain Noble: No; I never use but one, sir.

Mr. Brett: I have looked at Uranus for 17 years, and have never seen it look at all blue (laughter).

Mr. Ranyard: I should like to draw the attention of the Society to Dr. Vogel's pamphlet *On the Spectra of the Planets.* He gives the spectrum of Uranus with some very broad absorption bands, and I believe they coincide very well with the bands in the spectrum given by Mr. Huggins in a paper which possibly is not known to many of the Fellows of our Society, as it was communicated, not to us, but to the Royal Society, and was published in their proceedings.

In Dr. Vogel's paper there are also several smaller absorption bands, and if all of them are to be relied on we have really a great amount of evidence by which to estimate physical change with much greater exactitude.

Mr. Dunkin mentioned that he had a paper by the Astronomer-Royal, entitled *Report on the progress made in the calculations for a new method of treating the Lunar Theory.* The Astronomer-Royal had utilized Delaunay's calculations, and because

M. Delaunay had given no sufficient instructions to successors who might carry on the work, he had placed on record the methods of procedure which had been adopted by himself hitherto, and those which should be followed in completing the work.

The following papers were taken as read:—

Sir G. B. Airy: *On the Method to be used in reducing the observations of the Transit of Venus*, December 8, 1874, communicated by the Author.

Dr. W. Doberck: *New elements of* μ^2 *Boötis.*

Captain Bigg Wither: *Description of the Transit of Venus as observed at Mooltan, Punjab, India,* communicated by the Author.

Mr. John Hartnup: *On the application of corrections for change of Temperature to the rates of Chronometers at Sea,* communicated by the Author.

Messrs. Wilson and Seabroke: *Catalogue of Micrometrical Measurements of Double Stars made at the Temple Observatory, Rugby*, communicated by the Authors.

Lord Rosse: *Observations of the Satellites of the Planet Uranus, made at Birr Castle during the years* 1872, 1873, *and* 1874, communicated by the Author.

Mr. Joseph Gledhill: *Measures of* 485 *Double Stars, made at Mr. Edward Crossley's Observatory, Bermerside, Halifax,* communicated by the Author.

Mr. John Tebbutt: *Additional observations of Comet III.*, 1874 (*Coggia*), communicated by the Author.

M. Palisa: *Discovery of Minor Planet* (143) *by M. Palisa,* communicated by the Secretary.

Mr. A. Marth: *Ephemeris for physical observations of Mars at the opposition of* 1875, communicated by Mr. De la Rue.

Mr. J. E. Gore: *Note on the Transit of Venus*, communicated by Mr. Browning.

REVIEWS.

Science Primer. Astronomy by J. Norman Lockyer, F.R.S., Correspondent of the Institute of France, author of "Elementary Lessons in Astronomy," &c. Macmillan & Co. 1874. 32mo, 120 pages.

This is an attractive-looking little book, obviously intended for very small children; the sentences are short and the style, though somewhat abrupt and colloquial, has the merit of being familiar and at times attractively simple, but the author occasionally permits himself to use long words without explanation, such, for example, as "culmination," "intercept," "imaginary axis," "southing."

The first few pages of the book are thrown into pleasant little paragraphs, which remind us of a mother talking to a child. They are almost too simple, but are no doubt fitted to interest and amuse young children, a very necessary preliminary to instructing them. Let us take, as an example, the following from page 5: "Now, if you watch a ship going

away from you, the hull will disappear first. Now what does this mean? Let us make an experiment. Get a smooth table on which there are two flies, let us say, and if the flies are not there pretend that they are, and suppose them to be moving about. Now, it is clear that the flies, as long as they keep on the surface of the table, will always be in full view of each other. They will look smaller to each other when they are furthest apart, and larger when nearer each other; but one part of the fly will not disappear, the other parts being left visible, as in the case of the ships—therefore the surface of the sea is not flat like the surface of the table."

The term "experiment" is, perhaps, hardly a suitable name for the mental process which the child is here invited to go through. It is not led to fresh truth by reason of any experience of its own, but rather by an assertion that is made as to what *would be* the experience of the flies, and from this assertion a deduction is drawn which we venture to think will not bear close investigation. What would Mr. Hampden, for example, say to this syllogism. The table has the quality flatness; the sea differs from the table as to the possession of another quality, namely, the visibility of objects upon its surface at a distance, therefore the sea differs from the table as to the possession of the first quality, flatness.

Next to accurate reasoning, perhaps the most important requisite for a school book is the accurate use of the terms employed, but this has not always been attended to, and occasionally even common words are made use of in a way that we think cannot fail to mislead a child; take for example the word edge in the following paragraph from page 11, "What do we mean when we say that a star or the sun rises or sets? We mean that it is just passing either up or down over the edge of the earth, seen from the place where we are; the sun or star in fact does, or appears to do, just what the ships referred to did. A ball of worsted or an orange would make this quite clear. Put it on the middle of a table, and stick a pin into its side, the pin's head to represent your eye. Now imagine yourself to be the sun or a star, and walk round the table."

After page 30 the style somewhat changes, becoming less simple and more suitable perhaps for children of twelve or fourteen, but nowhere is anything attempted beyond very elementary astronomy.

The book is amply illustrated with a picture on nearly every page. Some of the woodcuts are new to us, but we recognise many of them as *clichés* taken from the pages of popular French works on astronomy. We do not remember to have seen fig. 43 before, and until some further explanation is given we must attribute to Mr. Lockyer the credit of having designed it—it represents the orbit of a double star.

In the text we are told that many double stars are "so close that one revolves round the other, just as we revolve round the sun," and from the woodcut it becomes evident that this accurately expresses the author's idea, for one star is drawn as describing an elliptic orbit, while the other is represented as stationary in one of the foci. No hint is given as to the difference between relative and actual orbits, and a child would doubtless ask which star is it that stands still in the focus?

On page 87, in speaking of the solar surroundings, we are told that the "vapours get brighter nearer the sun, and form an envelope round him called the chromosphere, and these can be observed by a special method." We would suggest that it would have been better instead of mystifying children by the "special method" to have said, and these can be observed at any time by pointing a spectroscope to the sun's limb, but possibly our author has some special reason for this little mystification.

On page 116 occurs the following remarkable statement, "Now, the

attractive power of bodies is in proportion to the amount of matter they contain. For instance, if the earth were doubled in size, still being made of the same materials, it would attract everything on it with double the force it now does.' It is hardly necessary for us to point out that this would not be the case, unless the amount of matter in the earth were, instead of being doubled, increased eight-fold, for the centre of gravity of the earth would, with the increase of size, be removed to a greater distance. In the case assumed by Mr. Lockyer the diameter of the earth would be increased in the proportion of $\sqrt[3]{2}$ to 1, and gravity on the surface would really only be increased in the proportion of $\sqrt[3]{2}$ to 1.

It is evident that this is not a mere slip, or printer's error, for a little further down we have, "If our earth were *doubled* in size, a pound weight would still balance another pound weight in the scales, for both would have their weights increased really to *two* pounds." This hardly does credit to a *Correspondent of the Institute of France.*

We have thought it well to expend so much time upon the review of this little book as we are informed that it has been recommended for use in Government schools. If such a recommendation has really been given, there will, in all probability, be a second and many succeeding editions; but before it again passes through the press, we would strongly advise the author to devote a little time to the study of elementary mechanics; and we would specially recommend a perusal of the first two sections of Newton's "Principia," before re-writing the last chap er, in which the action of gravity upon the moon is compared to that of a sling upon a stone.

The Origin of Creation; or, The Science of Matter and Force. A New System of Natural Philosophy. By Thomas Broderick Fraser, M.D., and Andrew Dewar. Longmans. pp. xxxvi. 252.

According to the theory of this book, *one* law, called *Atomagnetism,* controls all the phenomena of nature. *Matter is composed of two classes of atoms, mineral and vegetable; or, as they are often called throughout the work, hydrogen and oxygen. Every atom is a magnet having polarity. Like atoms attract. Like poles repel, and unlike poles attract.* P. xxxiv. The book is marked from beginning to end by a lofty tone of assumption little suitable to the evidently superficial acquaintance of its authors with the theories they believe they have overturned. Here are a few extracts:—The undulatory theory of light is proved to be erroneous for this among other reasons, "Again, if we hold a piece of glass before us, we can see Jupiter through it. The waves being communicated through the ether, which is *everywhere and in everything,* glass included, of course it goes through it to our eye. But suppose we hold a piece of cloth before us—which is much more porous than glass—we cannot see Jupiter. *Waves* and *ether,* therefore, have nothing whatever to do with seeing the star, but sight and a transparent medium, everything." The following is an argument against the received origin of colour: "Again, by the accepted theory, a bouquet of flowers ought to be colourless at night, but if we hold them to this mineral flame, we see the natural colours of the flowers just as in daylight, thus proving the fallacy of the assertion that everything is colourless, and that it is the sunlight that gives them, or indeed, any thing else, their colour." (p. 96). The ordinary theory of the tides will not bear even the slightest examination. "In the first place, how the moon, being the smaller body, could attract the earth, the larger body, is a mystery, for according to all rules of attraction or gravitation, the greater

always influences the less. Secondly, the same rule applies to the question, Why does the sun, the larger body, not exercise a greater attractive influence over the tides than the moon? Thirdly and lastly, if the moon draws the earth in, or the earth 'recedes' from the water at the side more distant from the moon, it follows that, as the tides are rising and falling continuously from one part of the globe to another, the earth is gradually receding from the water hour by hour, and accordingly ought to be approaching nearer and nearer to the moon every day. This, however, is not the case, and would be indignantly denied even by Lardner himself, but it is the only logical conclusion to which his theory leads." (p. 193.) Messrs. Fraser and Dewar would seem to be earnest men, and their work is not in places without a certain amount of ingenuity. For their own sake we regret its appearance. In a field which their travelled experience and, for aught we know, professional skill, would enable them to occupy with credit, they might have something to say well worth attending to. As it is, we fear the "shipwrecked observer" whom they describe as "drowning amidst the swelling seas of opposing theories and systems," will scarcely be benefitted by the "taper" which they tell us they have "had the temerity to light" for his guidance.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

NEW METHOD OF PHOTOGRAPHING SUN SPOTS.

Sir,—It will be interesting to those observers who occupy themselves in ascertaining the number of sun spots to learn a new method of photographing them, by means of which not only can their nnmber be determined but also their exact position, and that in a very short time and a very easy manner.

For this purpose we place, where the most effective chemical rays unite, a layer of chloride of silver, this being allowed to receive the sun's image, formed by a telescopic object-glass or speculum, the mounting of which is driven by clockwork. A brown solar disc is produced in a few seconds, in which the spots show themselves very distinctly as lighter marks.

In order that the exact position of the spots may be ascertained, to assist in the calculation of their heliographical co-ordinates, a glass, accurately divided into squares by cross parallel lines, is so placed, before exposure by observation, on a spot, that they are parallel to the sun's daily motion. This glass net is placed in direct contact to the sensitive layer during exposure, and the lines are therefore sharply delineated across the picture of the sun's disc.

The great advantage of this method consists in its simplicity. No chemical preparation of the sensitive film is needful, as it can be purchased ready for use. The picture is at once produced, no developing solution being needed. No apparatus is required for securing an instantaneous exposure, the use of which is attended with difficulty. The

exposure is regulated by a cap over the object-glass, which can be moved by means of a wire, from the eye-piece end of the telescope.

I have used Obernetter's (of Munich) excellently prepared collodion paper as a sensitive-material. The pictures obtained on this are very sharp, and the paper itself can be kept for months in a dark, cool, and dry place without its sensitiveness being impaired. The position of the spots on the photographs should be read and recorded either in softened day or lamp light, with the assistance of the parallel cross lines.

In small instruments in which the image of the sun is under two inches a magnifying apparatus will be necessary. I have during my experiments employed both an 11-inch and a 9-inch refractor; however, in these instruments the aperture was reduced to 4 inches, to avoid overheating the graduated glass plate. Under these circumstances it is possible in summer to produce a picture with an exposure of 8 or 10 seconds, in which the contour of the sun's edge and of the spots appear boldly.

Should it be desired to keep the photograph longer than necessary to take a second picture of it, the exposure should be 4 or 5 seconds more, and the desired shade of colour given in the toning and fixing baths, whilst it is less suitable for reading off.

I would add that I am willing to give a drawing of my photographic camera, as I use it for this purpose, to those gentlemen who are interested in this method and who wish to employ it.

Yours truly,

Berlin: Feb., 1875. H. OSW. LOHSE.

[The proofs sent by Professor Lohse are excellent.—EDITOR.]

NEW VARIABLE STAR.

On the 14th of the present month, while examining a part of Monoceros, with which I was pretty well acquainted, I was struck with the appearance of a strange 7-mag. star, with a fine red-orange colour. My belief that it is a new variable has been confirmed by my friend, Mr. Lynn of the Greenwich Observatory, who does not find it in any catalogue. During a short observation I was able to make out its position very roughly as follows:—α = 7h. 23m. 22s.; $\delta = -10° 4' 7''$, magnitude 7·3.

Millbrook, Tuam: J. BIRMINGHAM.

February 22, 1875.

NOTES ON THE TRIPLE STAR, 30 PEGASI.

This is No. 962 of Sir John Herschel's Third Catalogue of Double Stars, where it is entered:—

AB	D = 4·″ ±	P = 30·° ±	mags. 5, 20.
AC	5′—6·′	210·±	19.

Herschel adds this note—"Twice observed; the nearer star not seen in the first observation. A, B, and C are precisely in a straight line." In the Fifth Catalogue he measured the angle of C twice, the mean value being 212·°0, and rated its magnitude 19 in one observation, and 20 in the other. He failed to see the closer companion B on both occasions, and

speaks of C as the "most difficult object imaginable." So far as I can learn there is no observation recorded of this star since Herschel's last, about 1830. Last summer, while using the 9·4in. Clark refractor of the Dartmouth College Observatory, I picked it up by accident, and noted it as follows :—

$$\begin{matrix} AB & D = 5''' & P = 20^{\circ} \\ AC & 10'' & 220^{\circ} \end{matrix} \Big\} \text{ B and C of about the same mag.} = 14\text{m.}$$

It is one of the most beautiful objects of the kind I have seen. Both companions were detected with the utmost ease, and it could not be regarded as a test for anything much exceeding 7in. The companions seemed to be peculiarly bright, sharp points of light, and to belong to the class of satellites where a low power can be most advantageously used. Finding subsequently the star was not new, I gave it no further attention. My estimates of angles and distances were made before identifying the object, and not afterwards checked. As will be seen, I have placed the more distant companion 20° from the line joining A and B, and made its distance about twice as great, with no obvious difference in brightness. Of course, being only off-hand estimates, these figures are in error to a greater or less degree.

The superiority of modern refractors over the old reflectors may be inferred from the fact that Herschel used in all his observations a 20ft. reflector, and yet he recorded very few pairs beyond the reach of a 6in. Clark refractor. I am not at all certain that the companions to the star in question could not be seen with my own instrument of that aperture under the best atmospheric conditions. The omission of 30 Pegasi in the Dorpat and Pulkowa Catalogues is unaccounted for, but it is only one of several hundreds overlooked by the Struves, and the wonder is that in a survey of the whole northern heavens so little was left for later discovery. Variability in the small stars might be suspected, but as the first double star is yet to be found where there is any well established change in the magnitude of one of the components, that is at least improbable.

Chicago : S. W. BURNHAM.

March 4, 1875.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN APRIL, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXII. British Association map, 50° to 55° S. latitude.

Thirty-seven degrees from the moon's western limb Biela (392) (*a*) 6°, Rosenberger (389), Vlacq (388) 3°, Pitiscus (386) the south part, Hommel (387) 7°, Bacon (368) 8°, Cuvier (356) the south part, Jacobi (395) the north part, Lilius (394) in 5° west longitude, Delne (194) the north part in 2° east longitude, Maginus (195) the south part 10°, Longomontanus (192) the south part 8°, Bayer (235), Schiller (234) the south part 10°, Phocylides (242).

(*a*) Between the limb and Biela there are several large unnamed craters, there are also three between Biela and Vlacq.

In our list for October, 1874, Vol. XII. p. 253, we called attention to the recovery by M. Gaudibert of the three small craterlets IVA ζ 62, IVA ζ 63, IVA ζ 64. We have now to chronicle an important observation, also by M. Gaudibert, recorded in a letter under date March 17,

1875, from which the following extract is taken. "On the 15th [March, 1875] at 6 p.m., I again turned my telescope upon Halley. The floor was now in full light. and I was not a little surprised to have my eye almost forcibly attracted by a very white craterlet, situated on the S.E. extremity of the floor. This object does not at all occupy the position of craterlet IVA η 27. I tried to see this last object, but it was with great difficulty that I saw a marking at its place, and it would have been impossible for me to say what its nature was on account of the fluttering air, but the white craterlet on the S.E. was quite distinct as such, notwithstanding the state of the atmosphere. Comparing this craterlet with IVA ζ 62, IVA ζ 63, and IVA ζ 64 of Lohrmann, I found that these three were smaller in size and visible only as hillocks, while the craterlet in Halley was a comparatively *very easy* object. You will easily see that we are here in presence of a fact which obliges one to accept the belief in an actual activity in the moon. Rutherfurd's photogram shows a craterlet near the western extremity of the floor of Halley, but gives no other marking on the floor. On the 15th inst. I could hardly see Rutherfurd's craterlet, while I could see easily another craterlet on the S.E. not given on the photogram. It is evident that if the craterlet on the S.E. had existed at the moment when another but smaller craterlet on the west was printed on the plate, the larger and far more brilliant one would also have been imprinted there."

While quite agreeing with M. Gaudibert that the fact witnessed by him, viz., the apparition of a larger and brighter craterlet on the S.E. floor of Halley when a *measured* craterlet given by photography was scarcely discernible, obliges us to accept the belief of an actual activity in the moon, it is necessary to bear in mind that the long and searching scrutiny of the floor of Plato at least suggests the possibility of this larger craterlet having been obscured when Rutherfurd took his photogram; still of all the observers at present engaged on the moon M. Gaudibert is certainly engaged on the right track. A few more energetic observers devoting their attention to Hipparchus and Halley would accumulate a mass of similar facts, tending to remove further back the boundary line between doubt and certainty. The whole of the region under consideration has been most carefully examined, and assuredly such a crater as seen by M. Gaudibert has not before been found. On the 16th of October, 1866, Mr. Ingall examined the floor of Halley, and saw nothing of the kind. In order to indicate the amount of care bestowed on this part of the moon we quote the following description of the smaller craterlet IVA η 27 from Outline Lunar Map, area IVA η p. 7. "A craterlet on the floor of Halley. Diameter 1.″5, magnitude 0·09, the seventeenth in order on area IVA η, brightness, Rutherfurd, 4·°5 provisional, 4·°6 general scale."

The craterlet on the S.E. floor of Halley is the *seventh* new object which M. Gaudibert has contributed to the monogram of Hipparchus; the previous ones are IVA α 110, a mound on the west border of the cleft IVA ζ 101, and the continuation of this cleft in IVA α 111. IVA β 111 a craterlet south of Horrox and IVA β 112 a mound close to the south border of Horrox, IVA ζ 147 a mound on the east border of the valley IVA ζ 85, and IVA ζ 148 a peak in the ancient ring IVA ζ 58. These objects, with the exception of the newly discovered craterlet, are inserted in the monogram of Hipparchus.

M. Gaudibert also observed an interesting object known as IVA α 24. He says that on March 14, 1875, 8 p.m., it was seen as a mountain, on the top of which was a depression like a crater, but no opening on the north-east. This object is thus described in the Report of the British Association,

1866, p. 252. "A somewhat shallow crater opening into the valley IVA *a* 29. It is in the line of disturbance IVA *a* 5—IVA *a* 7. Diameter 6·″66, magnitude 0·39." 1867, October 17, 13 to 15 hours G.M.T, the Rev. W. O. Williams observed this object as a depression of ground, with no appearance of a crater, having a low ring all around, and no opening into the valley IVA *a* 29. See monogram of Hipparchus, p. 19, IVA *a* 24 is not found on Gill's photogram of May 18, 1869.

It will be seen from the above extracts that both Mr. Williams and M. Gaudibert agree in the absence of an opening of the crater into the valley IVA *a* 29, although they disagree as to the appearance of the crater. Lohrmann seems to have been the first observer of this object, which should be carefully watched.

THE PLANETS FOR APRIL.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	23 7 35	S. 7 48½	7″·0	22 26·1
	9th	13 47 3	S. 4 9½	6″·2	22 34·1
	17th	0 32 26	N. 0 48	5″·6	22 47·9
	25th	1 23 59	N. 6 48	5″·4	23 7·8
Venus ...	1st	22 7 34	S. 11 48½	16″·6	21 26·3
	9th	12 43 20	S. 8 53½	15″·6	21 30·5
	17th	13 18 41	S. 5 41	14″·8	21 34·3
	25th	23 53 47	S. 2 15½	14″·2	21 37·9
Mars ...	1st	17 32 55	S. 23 10½	12″·2	16 52·4
	9th	17 46 3	S. 23 26	13″·2	16 34·0
	17th	17 57 35	S. 23 49	14″·2	16 14·1
	25th	18 7 10	S. 24 7	15″·6	15 52·2
Jupiter ...	1st	13 48 46	S. 9 35	41″·2	13 8·8
	9th	13 45 6	S. 9 14	41″·6	12 33·7
	17th	13 41 15	S. 8 52	41″·6	11 58·5
	25th	13 37 26	S. 8 30½	41″·6	11 23·2
Saturn ...	18th	21 47 47	S. 14 26½	14″·6	19 59·7
	26th	21 49 54	S. 14 17	14″·8	19 30·4
Uranus ...	3rd	8 55 51	N. 18 4	4″·2	8 8·8
	15th	8 55 20	N. 18 6	4″·2	7 21·2

Mercury rises about 30m. before the sun at the beginning of the month, the interval decreasing to 12m. by the last day.

Venus rises an hour and a quarter before the sun at the beginning of the month, the interval decreasing to 1h. at the end of it.

Mars rises on the 1st, an hour after midnight, the interval gradually decreasing.

Jupiter is visible throughout the night, rising a little before 8 o'clock p.m. at the beginning of the month, and then earlier each night. He sets at 4·27 a.m. on the 30th.

Saturn may be observed in the morning, rising on the 1st, 1 hour and a quarter before the sun, the interval increasing.

ASTRONOMICAL OCCURRENCES FOR APRIL, 1875.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
Thur	1		Sidereal Time at Mean Noon, 0h. 37m. 45·07s.			Regulus 9 22·4
Fri	2	0 12	Conjunction of Moon and Saturn, 3° 33′ N. Conjunction of Moon and Venus, 3° 56′ N.	2nd Sh. I. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E.	12 0 12 45 14 31 15 9	9 18·5
Sat	3	19	Conjunction of Moon and Mercury, 0° 33′ N. Sun's Meridian Passage 3m. 24·53s. after Mean Noon	1st Sh. I. 1st Tr. I.	15 35 15 55	9 14·6
Sun	4			2nd Oc. R. 1st Ec. D. 1st Oc. R.	9 20 12 57 2 15 24	9 10·6
Mon	5	18 35	● New Moon Eclipse of the Sun invisible at Greenwich	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E. 3rd Ec. D. 3rd Oc. R.	10 4 10 21 12 17 12 32 13 6 27 16 6	9 6·7
Tues	6			1st Oc. R.	9 50	9 2·8
Wed	7					8 58·8
Thur	8					8 54·9
Fri	9			2nd Sh. I. 2nd Tr. 2nd Sh.	14 34 14 58 17 5	8 50·9
Sat	10	6 57 8 2	Occultation of B.A.C. 1746 (6½) Reappearance of ditto			8 47·0
Sun	11	14	Conjunction of Venus and λ Aquarii (4·6m.) W. Saturn's Ring: Major axis=36″·15 Minor axis=7″·57	2nd Ec. D. 2nd Oc. R. 1st Ec. D. 1st Oc. R.	8 53 50 11 35 14 50 44 17 8	8 43·1
Mon	12	9 33 8 17	☽ Moon's First Quarter Near approach of *c* Geminorum (6)	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 58 12 5 14 11 14 16	Jupiter. — 12 20·5
Tues	13	19	Conjunction of Mars and 4 Sagittarii 0° 8′ S.	1st Ec. D. 1st Oc. R.	9 19 11 11 34	12 16·1
Wed	14			1st Sh. E. 1st Tr. E.	8 39 8 42	12 11·7
Thur	15	9 11	Conjunction of Venus and φ Aquarii (0·3m) E. Conjunction of Venus and φ Aquarii 0°·1′ S. Illuminated portion of disc of Venus=0·727 Illuminated portion of disc of Mars=0·906			12 7·3

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Jupiter.
Fri	16	14 45 15 39 17	Occultation of σ Leonis (4) Reappearance of ditto Opposition of Saturn and Sun	3rd Tr. I. 3rd Tr. E. 3rd Sh. E.	6 59 8 50 9 2	— 12 2·9
Sat	17	8	Conjunction of Mars and 4 Sagittarii (4·9m.) W.			11 58·5
Sun	18		Sidereal Time at Mean Noon 1h. 44m. 46·49s.	2nd Oc. D. 2nd Ec. R. 1st Oc. D.	11 26 13 56 59 16 40	11 54·0
Mon	19	23	Conjunction of Moon and Jupiter, 2° 36′ N. Sun's Meridian Passage 0m. 51·52s. before Mean Noon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	13 49 13 52 16 0 16 5	11 49·6
Tues	20	4 30·0	○ Full Moon Conjunction of Neptune and Sun	2nd Tr. E. 2nd Sh. E. 1st Oc. D. 1st Ec. R.	8 43 8 56 11 6 13 20 53	11 45·2
Wed	21			1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	8 15 8 21 10 26 10 34	11 40·8
Thur	22	17 3	Near approach of B.A.C. 5253	1st Ec. R.	7 49 19	11 36·4
Fri	23			3rd Tr. I. 3rd Sh. I. 3rd Tr. E. 3rd Sh. E.	10 5 10 42 12 9 13 0	11 32·0
Sat	24					11 27·6
Sun	25	8	Conjunction of Moon and Mars 4° 24′ N.	2nd Oc. D. 2nd Ec. R.	13 41 16 33 14	11 23·2
Mon	26	14 17	Near approach of B.A.C. 6628	1st Tr. I. 1st Sh. I.	15 33 15 46	11 18·8
Tues	27			2nd Tr. I. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E. 1st Oc. D. 1st Ec. R.	8 31 8 59 10 56 11 30 12 50 15 14 45	11 14·4
Wed	28	7 17 2	☾ Moon's Last Quarter	1st Tr. I. 3rd Sh. I. 1st Tr. E. 1st Sh. E.	9 59 10 15 12 11 12 28	11 10·0
Thur	29	12	Conjunction of Moon and Saturn 3° 20′ N.	1st Ec. R.	9 43 12	11 5·6
Fri	30			3rd Tr. I. 3rd Sh. I. 3rd Tr. E.	13 31 14 42 15 39	11 1·2
MAY Sat	1	14	Uranus in quadrature with the Sun			10 56·8

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat. of the centre of the sun's disc.	Angle of position of sun's axis.
1875.	°	°	°	°
April 1	89·65	13·21	−6·43	333·61
2	102·86	·21	6·38	333·57
3	116·07	·21	6·32	333·54
4	129·28	13·22	−6·25	333·52
5	142·50	·21	6·19	333·51
6	155·71	·21	6·12	333·50
7	168·92	·22	6·06	333·50
8	182·14	·21	5·99	333·51
9	195·35	·22	5·92	333·52
10	208·57	·22	5·84	333·54
11	221·79	13·22	−5·77	333·57
12	235·01	·21	5·69	333·61
13	248·22	·22	5·62	333·65
14	261·44	·22	5·54	333·71
15	274·66	·23	5·46	333·77
16	287·89	·22	5·37	333·83
17	301·11	·22	5·29	333·91
18	314·33	13·23	−5·20	333·99
19	327·56	·22	5·12	334·08
20	340·78	·23	5·03	334·17
21	354·01	·22	4·94	334·28
22	7·23	·23	4·85	334·39
23	20·46	·23	4·76	334·51
24	33·69	·23	4·66	334·63
25	46·92	13·23	−4·57	334·76
26	60·15	·23	4·47	334·90
27	73·38	·23	4·38	335·05
28	86·61	·23	4·28	335·21
29	99·84	·23	4·18	335·37
30	113·07	·24	4·08	335·54
May 1	126·31		−3·97	335·71

A.M.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF JUPITER.

Greenwich Midnight.	Longit. of meridian turned to the Earth.		Angle of posit. of ♃'s axis.	Annual parallax.	Latitude of Earth above ♃'s equator.	Latitude of Sun above ♃'s equator.
1875.	°	°	°	°	°	°
April 1	109·3	870·8	22·05	−3·05	−3·24	−2·89
2	260·1	·7	22·07	2·85	3·24	2·89
3	50·8	·8	22·10	2·65	3·24	2·90
4	201·6	·7	22·13	−2·45	−3·23	−2·90
5	352·3	·7	22·16	2·25	3·23	2·90
6	143·0	·8	22·18	2·05	3·23	2·90

7	293·8	·7	22·21	1·85	3·22	2·90
8	84·5	·8	22·23	1·66	3·22	2·90
9	235·3	·7	22·26	1·46	3·22	2·91
10	26·0	·7	22·29	1·26	3·21	2·91
—						
11	176·7	·8	22·31	—1·06	—3·21	—2·91
12	327·5	·7	22·34	0·86	3·21	
13	118·2	·7	22·37	0·65	3·21	
14	268·9	·8	22·39	0·45	3·20	
15	59·7	·7	22·42	0·25	3·20	
16	210·4	·7	22·44	—0·05	3·20	
17	1·1	·8	22·47	+0·16	3·19	2·91
—						
18	151·9	·7	22·49	+0·36	—3·19	2 92
19	302·6	·7	22·52	0·57	3·19	
20	93·3	·7	22·54	0·77	3.18	
21	244·0	·8	22·57	0·97	3·18	
22	34·8	·7	22·59	1·17	3.17	
23	185·5	·7	22·62	1·37	3.17	
24	336·2	·7	22·64	1·57	3·17	
—						
25	126·9	·7	22·67	+1·77	—3.16	—2·92
26	277·6	·7	22·69	1·97	3·16	2·92
27	68·3	·7	22·72	2·17	3·15	2·92
28	219·0	·7	22·74	2·37	3·15	2·92
29	9·7	·7	22·76	2·57	3·14	2·93
30	160·4	·7	22·79	2·76	3·14	2·93
May 1	311·1	870·7	22·81	+2·96	3·13	—2·93
						A.M.

EPHEMERIS OF ENCKE'S COMET FOR 1875.

By Dr. E. von Asten.

(From a communication addressed to the Academy of Sciences of St. Petersburgh.)

January, February, and March being over, the extract from No. 2030 of the *Astronomische Nachrichten* here given for the use of the readers of the *Astronomical Register* commences on the 1st of April.

0h. Berlin M. Time. 1875.	R.A. h. m. s.	Decl. ° ′ ″	Comet's Log. distance From Sun.	From Earth.
April 1	2 0 6·45	+17 9 18·5	9·66435	0·06660
2	2 3 46·01	17 14 14·8	9·64817	0·05637
3	2 7 23·31	17 17 18·3	9·63196	0·04560
4	2 10 56·60	17 18 10·2	9·61586	0·03427
5	2 14 23·76	17 16 29·2	0·60008	0·02234
6	2 17 42·22	17 11 51·4	9·58485	0·00980
7	2 20 48·95	17 3 50·6	9·57049	9·99663
8	2 33 40·44	16 51 58·8	9·55730	9·98286
9	2 26 12·80	16 35 47·6	9·54570	9·96850
10	2 28 21·92	16 14 48·3	9·53608	9·95358
11	2 30 3·63	15 48 35·5	9·52879	9·93820
12	2 31 13·97	15 16 48·7	9·52413	9·92250
13	2 31 49·51	14 39 14·6	9·52235	9·90660
14	2 31 47·81	13 55 47·9	9·52351	9·89069
15	2 31 7·54	13 6 33·4	9·52756	9·87496
16	2 29 48·68	12 11 47·2	9·53431	9·85959
17	2 27 52·42	11 11 55·8	9·54347	9·84481
18	2 25 21·14	10 7 34·0	9·55468	9·83074

19	2 22 18·18	8 59 23·9	9·56754	9·81759
20	2 18 47·45	7 48 11·3	9·58169	9·80542
21	2 14 53·29	6 34 44·5	9·59676	9·79437
22	2 10 40·04	5 19 51·8	9·61245	9·78442
23	2 6 12·01	4 4 19·8	9·62851	9·77564
24	2 1 33·22	2 48 51·1	9·64471	9·76798
25	1 56 47·30	1 34 4·3	9·66090	9·76143
26	1 51 57·51	+0 20 32·3	9·67696	9·75590
27	1 47 6·63	—0 51 17·6	9·69278	9·75135
28	1 42 17·02	2 1 3·5	9·70831	9·74768
29	1 37 30·59	3 8 29·4	9·72349	9·74482
30	1 32 48·85	—4 13 24·0	9·73830	9·74267

From the above it will be seen that the comet's nearest approach to the sun takes place on the 13th of April, and that it continues to approach the earth up to the end of the month. In point of fact its nearest approach to the earth occurs on the 4th of May.

NEW PLANET.

Discovery at Pola, by M. Palisa, of a new planet (143).
(From *Astronomische Nachrichten* No. 2029.)

1875. Feb. 23, 8h. 42m. 12s. mean time Pola.
Planet R.A. 9h. 57m. 57·03s. Decl. + 13° 46′ 8″·1. Magnitude 12.
This planet has been since observed at the Leipzig Observatory, viz.:
1875, Feb. 28. 10h. 15m. 36s. mean time Leipzig.
R.A. 9h. 52m. 59·72s. Decl. +13° 48′ 49″·5.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sep., 1873.
Bates, Rev. T. C.

To Sep., 1874.
Little, W.

To Dec., 1874.
Solomons, Messrs. S. and B.

To Feb., 1875.
Weldon, Mrs.

To Mar., 1875.
Bagnall, J. N.
Field, H.
Hendry, W.
Huggins, Dr. W.
Knobel, E. B.

To June, 1875.
Guyon, C.
Rivaz, Miss.
Sargent, Rev. J. P.
Squire, H.

To Sep., 1875.
Cumner, A.
Lewis, H. K.

To Dec., 1875.
Abbott, F.
Armbruster, C.
Perigal, H.
Shawcross, M.
Whitbread, S. C.

To Jan., 1876.
McAdam, J. V.

TO CORRESPONDENTS.

We are obliged to postpone Reviews and several interesting articles through want of space.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications, Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON. Hackney Collegiate School, *Clarence Road*, *Clapton*, *E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 149. MAY. 1875.

ASTRONOMICAL JOURNALISM.

Mr. Lockyer's articles in the *Times* have opened up quite a new era in English Astronomical Journalism. If the tastes of the public could with fairness be argued from the supply of information given in the paper, which is supposed rather to move with the age than to lead public opinion, we should judge that the transit of Venus had brought about quite an astronomical revival. It is not so very long ago since the astronomical appetite of the readers of the *Times* was appeased by a very occasional communication from Mr. Hind, and every now and then a little shower of letters from country gentlemen who had seen a meteor. Now the columns of our great contemporary bristle with polysyllables, "prismatic cameras," the "chromosphere" and "compound molecules" are treated of with a glibness that must turn the head of the typical pater-familias.

The series of articles of which we are speaking began with a review of the preparations for the observation of the transit of Venus, then followed discussions of the results as they were received by telegram, and frequent criticisms of the plans of the Astronomer-Royal, which, we thought, were conceived in a very unfriendly spirit, but of this we cannot complain. Mr. Lockyer had a perfect right to attack the Astronomer-Royal, even though he knew that the man whom he was attacking would not descend into the area of public journalism to defend himself. We should have preferred to see these attacks made openly, and not under

the cover of anonymous articles, or, better still, made before the Astronomical Society, or some other body of men whose special knowledge would fit them to judge of the merits of the case; but, we repeat, Mr. Lockyer had a perfect right to criticise after the manner of journalists—we had almost written everybody and everything—but there is one person and one set of things that we conceive no journalist has a right to criticise. In the good old times it was held to be a breach of literary etiquette for a man, when writing anonymously, to speak favourably either of himself or his own acts, and we are sufficiently old-fashioned in our notions to believe that self-praise is still no recommendation. The last two articles especially contain passages which would lead an unwitting reader to suppose that a third person was speaking in terms implying the highest commendation of Mr. Lockyer and his plans for the observation of the recent eclipse in Siam. If such articles had been printed anonymously in an astronomical journal like our own, the fault would not have been so great, for the number of popular astronomical writers is not legion, and most of our readers, we conceive, can pretty well judge by whom an astronomical article is written before they have read the first dozen lines, but we suspect that there were thousands among the readers of the *Times* who could have little suspicion as to the authorship of the passages to which we refer.

In the *Times* of April the 6th, after praising, in the highest terms, the simplicity of the plans, which are well-known to have been have proposed by Mr. Lockyer, for the spectroscopic observation of the recent eclipse, the article proceeds, "The photographs "of the corona which were so strongly insisted upon by Mr. "Lockyer in the observations of the eclipse of 1871, and objected "to (*sic*) by the Astronomical Society, were necessary to determine "the solar or non-solar origin of the corona. This question has "now been set at rest by showing that part of it is really at the "sun, and this is now called the coronal atmosphere. When this "was settled, it was suggested by the same observer, that this "atmosphere would be very likely found to vary in shape and "dimensions with the sun-spots." Mr. Lockyer appears to ignore the fact that his programme contained nothing but spectrum photography, and that, according to it, no attempt was to have been made to photograph the details of the corona at the minimum sun spot period; but this is a trifle!

When, on the 20th of April, telegrams had been received, showing that Mr. Lockyer's programme had failed, and that nothing further than spectroscopic images of the *chromosphere* had been obtained, we find another article, which, after quoting from "our

contemporary, *Nature,*" and acknowledging that the attempt to photograph the spectrum of the corona had proved futile, again proceeds to bestow the highest commendation on the arrangements which had been recommended for the observation of the eclipse.

If such self-laudation had been met with in the columns of *The Englishman* we should not have been surprised, but we are sorry to find these tactics creeping into astronomical journalism, and we hope that the remarks which we have thought it our duty to make will help to put an end to such articles. But if this is too much to anticipate, we certainly have a right to ask that for the future such paragraphs in the *Times,* and when reprinted in *Nature,* should be fairly and openly headed as articles by Mr. Lockyer on Mr. Lockyer.

ROYAL ASTRONOMICAL SOCIETY.

Session 1875—76.

Second Meeting of the Session, April 9th, 1875.

Professor Cayley, F.R.S., *Vice-President,* in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

The minutes of the last meeting were read and confirmed.

Forty-one presents were reported as having been received since the last meeting in March, and the thanks of the Society were voted to the donors.

The following candidates for the Fellowship of the Society were balloted for and duly elected:

David Winstanley, Esq., The Doctor's Cottage, Blackpool.

Colonel Archibald Campbell, of Blythswood and 42, Seamore Place, Curzon Street, W.

Carl Armbruster, Esq., F.C.S., Member of the Quekett Microscopical Club, 4, Grove Villas, The Grove, Hammersmith, W.

A paper by Professors Newcomb and Holden was laid before the Society. *Observations of the satellites of Saturn made in the year* 1874 *at the Washington Observatory.* The paper was communicated by Mr. Marth, who said it was exactly ten years that evening since Mr. Lassell and he made their last observations in Malta, and from that time up to the present, so far as he knew, no observations of the positions of the satellites of Saturn had appeared, either in England or America. He recommended observers possessing large instruments to pay attention during the present year to the satellite, Japetas, which would be in a position specially favourable for the determination of its orbit, and also to Hyperion, the theory of whose motion was very

complicated, indeed, there was no other body in the planetary system the theory of whose motion offered such special difficulties.

Mr. Dunkin read a paper which was communicated by Lord Lindsay, giving an account of the longitude-observations on the way from Mauritius homewards: at the conclusion of the paper,

The Astronomer-Royal said: It has always appeared to me that one of the collateral advantages of these expeditions for observing the transit of Venus would be the accurate determination of a number of longitudes of places which may for the future be considered as fundamental. Two circles of observations have been touched upon in this paper. The first is that of which Capt. Orde Browne was the head, and of which the central point was the station on the Mokattam Hills, above Cairo. The longitude of that station has been determined very carefully, by means of the greatest telegraphic effort that has ever been made. Direct time-observations were made throughout the long unbroken line from Porthcurno, in Cornwall, to Alexandria, and from thence there was direct telegraphic communication with the Mokattam station. The longitudes of Thebes, of Alexandria, and of Suez, have also been carefully determined. Suez was the connecting link between the two great circles. The second circle was that over which Lord Lindsay presided, and he from his central station, Mauritius, has sent out his expeditions in all directions, radiating like a spider's web. He has communicated with the Cape of Good Hope, with Aden, with Bombay, and with Rodriguez, where under the personal direction of Lieut. Neate an independent series of observations of the moon has been made.

Mr. Hunter: When Mr. Gill was going out to Mauritius, he chose a station at Suez, and took some observations close to the telegraph office; this was an excellent spot for longitude determination, but unfortunately the whole town of Suez lay between the station and the south-eastern horizon, and in addition to that it lay very low, so that the sun could not be observed until it was 10° high. The station which we selected was perhaps half a mile from Mr. Gill's site.

The Astronomer-Royal said: I have been furnished with a map showing both Mr. Hunter's and Lord Lindsay's stations. They were nearly in the same meridian, and perhaps a quarter of a mile apart.

Mr. Hunter said: The two stations at Alexandria and Suez, and the station on the Mokattam Hills, are, I understand, to be made three of the fundamental points of the triangulation of Egypt which is now going on.

Mr. Dunkin said: I will read a portion of a letter which has recently been received by one of the secretaries from Lord Lindsay

who is now ill with Mauritius fever, at Florence. He says, "I am now getting much stronger, and have fewer returns of fever, so that I hope to start for home in a fortnight or so. The fever has pulled me down dreadfully, I lost more than 14 lbs. in five days by it, just before leaving Port Louis, and, what is worse, I have lost all power of concentration."

The next paper read was by Mr. Wilson. *On the relative rectilinear motion of the two components of* 61 *Signi*. He quoted Struve's estimate of the very high probability of there being a physical connection between these stars, derived from their extraordinary common proper motion, and his expressions of surprise that the relative motion was nevertheless, up to his time, adequately represented by a straight line. Mr. Wilson, therefore, rediscussed the relative motion, making use of observations down to the present time, and found that the straight line of Struve would not satisfy recent observations, and yet a straight line which satisfied the observations of the present century failed to satisfy those of Bradley and Piazzi. His conclusion was that the path was very slightly concave. He was anxious that the distance and the position angle should be carefully observed with the best instruments for some years to come, and then the question of the orbit might be advantageously discussed.

The Astronomer-Royal said: I do not attach much importance to the proof of a physical connection between the two stars, derived from motions like these. They differ from the motions of several binary stars in this, that their paths do not appear to curve round one another. When there is such apparent revolution, it seems impossible to explain the paths, except by assuming that there must be a mutual attraction. I may illustrate this by a very common-place example. If you saw two men walking on London Bridge side by side, and one appeared to advance a little upon the other, and after a time the two appeared to separate more and more widely, we might conclude, so long as they were side by side, that there was some connection between them; but after they began to separate, if the one did not turn to wait for the other we should soon conclude that there was no connection between them. But in the case of double stars, the time we have to consider is a few thousand years, instead of a few seconds. In all observations like these, time is a very important element, and we must allow a very large license indeed before we speak of uniform motion. It must not be supposed that what has been seen during a period of 150 years (which is about the time since the first observations of double stars) represents uniformity any more than the parallel motion of two persons in the street for one second of time implies a connection between them.

Mr. Ranyard was called upon to give a description of an instrument for giving a monochromatic image of a circular slit. The principle of the instrument was that it increased the distance between the foci of the red and violet rays, as existing in the ordinary non-achromatic telescope, producing a greater dispersion along the axis of the telescope. A diagram of the instrument, which was somewhat complicated, was drawn on the black board. It involved the use of a convex parabolic reflector, and a convex elliptic reflector which passed the rays backwards and forwards, through different parts of two non-achromatic object-glasses, the several *annuli* of which serve as circular prisms to break up the rays. The object is then viewed through a hole cut in the centre of the elliptic reflector.

Professor Cayley read a paper *On a theorem in elliptic motion.* Comparing the time of passage between opposite points of an elliptic orbit with that of a particle falling in a right line, from rest to a certain distance from the centre of force.

A paper by Mr. Proctor was read *On photography in the transit of Venus,* at the close of the paper,

The Astronomer-Royal said: I am very anxious indeed that we should have a good and careful investigation of the different ways that will be adopted for determining the sun's parallax from the photographs. In looking over the original observations, I really am puzzled in all directions, and I cannot give any answer until an instrument has been constructed for measuring the photographs. Vague generalities are of no use to us, what we want are accurately observed facts. I must, however, protest most strongly against the introduction of reports of oral conversations into papers professing to bear a scientific character; and I trust that this Society will never give its aid to the publication of such reports.

Note on 61 *Geminorum*: by the Rev. T. W. Webb, of Hardwick. This star is entered in the Bedford Catalogue as double, $7\frac{1}{2}$ and 9 magnitudes, and A deep yellow. Mr. Webb examined it with a $3\frac{7}{10}$-inch telescope in 1852 and 1855, and entered it as single and white. Mr. Knott also with $7\frac{1}{3}$-inches found it single in 1861 and 1871. Recently Mr. Sadler, of Honiton Rectory, had observed B with a $6\frac{1}{2}$-inch silvered speculum. Mr. Webb concluded that B was probably variable, and that there might possibly be a change of colour in A, and he considered it deserving of attention.

At the conclusion of the reading of the paper, Capt. Noble said: At the last meeting I read a short note on a change of colour, which I then believed had taken place in Uranus. I have since observed the planet on the only fine night which we have

had since the last meeting, and I found that Uranus had gone back to its old colour.

Mr. Dunkin said: I am sorry to be obliged to appear before the Society again with a list of defaulters. About twelve months ago it was my duty to propose the expulsion of a number of Fellows who had neglected to pay their subscriptions, and again it is my duty to perform the same unpleasant office. I am really grieved to find how many Fellows of this Society there are who have gone on receiving the *Monthly Notices*, and the other advantages of being connected with us, without paying anything towards the expenses of the Society. I think that this default ought to be put a stop to, and that I should not be doing my duty as Secretary if I did not see that it did not go on any longer. I therefore beg to move that the following gentlemen, who are in arrear for the sums mentioned against their names, be, according to the words of the bye-laws of the Society, "publicly suspended as defaulters in the meeting-room," and should their arrears be still unpaid at the next evening meeting, I will move that the Chairman shall declare the said Fellows to be expelled the Society for non-payment. The following list of names was then read:

Mr. Alderman Carter	£18	18	0
Marcus Warburg, Esq.	18	18	0
Jabez Moden, Esq.	12	12	0
W. J. H. Beechey, Esq.	10	10	0
R. Brewin, Esq.	10	10	0
W. Hislop, Esq.	10	10	0
C. Baume, Esq.	8	8	0
Capt. H. Wood	8	8	0

These amounts include the subscriptions for the current year. I have written to each of these gentlemen, and very few of them have deigned to reply, so, that, as we have the law in our own hands we can do nothing but carry it out. These gentlemen will have an opportunity of paying the money, and so preventing their expulsion, within the next five weeks, during which time their names will remain suspended in this meeting-room.

Mr. Beck: May I ask whether the Society has not power to enforce the payment of these arrears?

The President: I believe that it is considered that the Society has the power, but such a thing has never been done, practically the remedy is expulsion.

Mr. Beck: I think the money ought to be recovered. I should like to ask the question, Are the proceedings of the Society supplied to those Fellows who are more than twelve months in arrear?

Mr. Dunkin: According to the bye-laws of the Society, when

a Fellow is two years in arrear the publications of the Society are no longer to be sent to him. He has no right to attend the meetings of the Society, and no right to use the initials F.R.A.S. We have hitherto been more lenient to defaulting Fellows in the matter of the publications of the Society, but I have given instructions to the Assistant-Secretary that for the future the *Monthly Notices* shall not be sent after the end of the second year.

Mr. Beck: I hope for the future that the rules as to this matter will be strictly carried out, for we have had a great many persons trading upon the letters F.R.A.S., which carry a certain amount of distinction, and yet they have not even paid the dues of the Society. I hope that for the future the rules will be strictly carried out with regard to such people.

Capt. Noble: There is one individual who has been expelled from this Society, and who has been driven from using the initials F.R.A.S. by a little circular which has been sent to the editors of papers, which have published these initials after his name, but now I understand that having been deprived of the initials F.R.A.S. he has started the letters F.R.S.

Mr. Phillips: I received an invitation card to a charitable dinner a few weeks since, on which was the name of the gentleman to whom I think Capt. Noble is alluding, and on that card were the letters F.R.S. and F.R.A.S. I certainly had not heard that he had been elected to the Royal Society. (Laughter.)

Mr. Beck: Would it not be advisable to give publicity to the expulsion, so that the general public may be aware of it as well as those who attended these meetings?

Mr. Dunkin: It has not been customary lately to publish the list in the *Monthly Notices*, but formerly, in the good old times, when gentlemen were expelled their names were printed in full in the *Monthly Notices* with the amount against them for which they were in arrear.

Mr. Beck: Would it be necessary to give notice of a motion that those names should be published in the *Monthly Notices?*

Professor Cayley: Notice certainly would be necessary.

Mr. Beck: I think it is exceedingly desirable that it should be made public. If it was published in our printed transactions it would probably get into other publications, and so the public would be warned of what at present they are utterly ignorant of. I was connected with a transaction in which there were two persons who wrongfully made use of these initials. I protested to the proper authorities, who informed me they had no wish to insert the letters, but they could not withdraw them unless I was able to prove to them that the two gentlemen had been removed

from the Society. For this purpose I was obliged to write to the Secretary, whereas if their names had been published in the ordinary way I should have been able to refer them to information which was public property, instead of making use of a private letter.

Mr. Ranyard asked Mr. Marth whether the occultation of Japetus by the ring and the disc of Saturn, during next May would be visible from this country.

Mr. Marth said that the occultation would not be visible, but there would be a transit in July which might be visible from England. Observers who possessed powerful telescopes would have an opportunity of seeing what had not been seen for the last 200 years, in fact what had not been seen since the discovery of the satellites of Saturn. On the 24th of May there would be an occultation by the ring and ball, but it would not be visible in England; then there would be a transit of the satellite across the disc on the 2nd of July, which might be observed in England if the satellite could be discerned. There would also be conjunctions on the 11th of August, and at some later dates. On the 30th of October there would also be an eclipse, and on the 8th of December a transit of the shadow across the disc, but the latter and some other phenomena in the early part of next year would not be visible here, as Saturn would be too near the sun.

The following papers were also laid before the Society and partly read:—

Mr. R. L. J. Ellery: *Measurements of the distance between Venus and the Sun during the transit of Venus, with Airy's double image micrometer,* communicated by the author.

Mr. E. Neison: *On an investigation by Bessel on the refraction through an atmosphere*, communicated by the author.

Mr. S. M. Drach: *Note on the supposed trapezoid shape of the sun's corona,* communicated by the author.

Mr. A. V. Nursinga Row: *Observation of the transit of Venus at Vizagapatam,* communicated by the author.

The meeting adjourned at half-past nine until the 14th of May.

MONUMENT TO PROF. DONATI.

An address is in circulation in Italy to raise subscriptions for a monument to the late lamented Prof. Donati. It carries the names of many public persons and professors, amongst whom are the Comm. Ubaldino Peruzzi (President), the Comm. Prof. Parlatore, and the Comm. Prof. Schiaparelli. If any of our readers are inclined to assist in this object, Mr. G. J. Walker,

Teignmouth, Devon, will receive and transmit the names, contributions, &c., &c. The circular is as follows:—

"The death of Giovambatista Donati was a loss to science not easily to be repaired. If he did much for the investigation and discovery of truths, that in the present day are opening to physical astronomy new and more extended horizons, he would certainly have done still more, if death, encountered by him in the cause of science itself, had not taken him away in the full vigour of his mind and years. On this account, the undersigned, enlarging upon the idea already worthily conceived by the professors of the Museum of Physics and Natural History in Florence, have united for the purpose of honouring the memory of the illustrious deceased, by a public monument, to be erected in the new observatory of Arcetri, which, originated by Donati, was by him during a long time forwarded, and finally brought to an end, with an unwearied constancy of purpose, notwithstanding all manner of obstacles. Thus, if fortune denied him the prosecution of his studies and researches among the celestial bodies from that place, his image there will remind posterity how well he deserved of astronomical studies in Italy, in this peculiar respect, amongst others.

"We therefore turn to all who have at heart the glories of science, and ask them to assist us in a work which is at once one of honour and of duty, and for the friends, of whom Giov. Donati had during his life many and worthy, one also of love and pious brotherhood after his death."

TRANSIT OF VENUS.

A letter lately received from Mr. Pogson, Government Astronomer, Madras, states—what has been known some time—that the transit of Venus was an utter failure there, the third contact being the only part of the phenomenon in *any* way observable. Mr. Pogson remarks that theoretical investigations have already yielded a closer approximation to the sun's parallax than any *single observation* method can attain to. He much prefers Sir G. Airy's Mars method, and trusts that he shall he able to show by it, from eight oppositions, a better result than the transit of Venus can afford. He says he is now very busy setting his public electrical clocks, and much extraneous work interferes with his legitimate astronomical duties. The want of English aid has so far been supplied by Mr. Pogson's daughter having been appointed *special assistant* to him, and with her help he hopes to begin to publish past observations.

MRS. SOMERVILLE.

"Last night at Miss Berry's I met Mrs. Somerville, the great mathematician. I had been reading in the morning Sedgwick's sermon on education, in which he talks of Whewell, Airy, and Mrs. Somerville, mentioning her as one of the greatest luminaries of the present day. The subject of astronomy is so sublime, that one shrinks into a sense of

nothingness in contemplating it, and can't help regarding those who have mastered the mighty process and advanced the limits of the science as beings of another order. I could not then take my eyes off this woman; with a feeling of surprise and something like incredulity, all involuntary and very foolish, but to see a mincing and smirking person, fan in hand, gliding about the room, talking nothings and nonsense, and to know that La Place was her plaything, and Newton her acquaintance, was too striking a contrast not to torment the brain. It was Newton's mantle trimmed and flounced by Maradan."—Feb. 14th, 1834.—"Greville's Memoir of William IV."

BABYLONIAN LIBRARIES.

"The oldest libraries were those of Babylonia, the mother country of the civilization of western Asia. Those of Assyria were established in imitation of the earlier ones of Chaldea, and the books with which they were stocked were mostly copies or later editions of Babylonian works. * * * Babylonia has not yet been excavated, and our knowledge of these libraries is accordingly confined to the contents of the libraries of Sennacherib, the larger part of which has been brought from Nineveh to the British Museum. Most of the works in the Museum are later editions of older Babylonian texts. * * * Among the most curious of these works is a long one, in seventy tablets or books, on astronomy and astrology, which was drawn up for a Babylonian monarch, who reigned about 2000 B.C. The catalogue of this work mentions separate treatises on the Pole-star, on comets, on the movements of Venus, &c., and at the end tells the reader to write down the number of the table he wishes to consult, and the librarian will thereupon hand it to him." [Amongst the great variety of Assyrian and Babylonian literature now in the British Museum, both prose and poetry, is an epic which] "came from Ereeh, and consisted of twelve books, each answering to a sign of the zodiac, and relating to the adventures of a solar hero." Also, "Tables of cube roots and other mathematical formulæ." * * * The librarians were called "the men of the written tablets." The first librarian of whom we know was a certain Mul-Anna, the son of Gandhu. His signet-cylinder is now in Europe, and we learn from it that he presided over the library of an early Accadian king of Ur. Ur is the city mentioned in Genesis as the birth-place of Abraham, and the signet must be assigned to a very ancient date—more than 4000 years ago. Such is the antiquity of the office of librarian, and of the respect paid to books."—A. H. S., Oxford.—From *The Bookseller* for April, pp. 305, 306.

REVIEWS.

The Aerial World. A popular account of the phenomena and life of the atmosphere. By G. Hartwig, M. and P.D., author of "The Sea and its living wonders," "The Tropical World," "The Polar World," and "The Subterranean World," with plates and numerous woodcuts. Longmans, Green, and Co., 1874. [Price 21s.]

This is not intended to be a handbook of Meteorology. The author says, "My less ambitious aim was merely to give a general view of the phenomena of the atmosphere, to point out the manifold relations between the aerial ocean and man, and to describe the life of which it is the ever busy scene." Nevertheless a very large amount of accurate information

is given in a remarkably pleasing manner, and the volume combines entertainment and instruction to a very great degree. The illustrations are good; and it is furnished with a useful index. We give an extract, pp 352, 353, about aerolites. "So much is certain, that no mineral substances we know of afford a higher interest to the reflective mind than the aerolites. All other bodies we see around us belong originally to the substance of our earth, but here, and only here, the erratic boulders of another world are submitted to our view. We are able to touch bodies whose mysterious birthplace lies far beyond the utmost limits of our atmosphere; they come to us we know not whence, they were formed we know not how! They are the ponderable witnesses that the elements which compose the solid mass of our globe exist also beyond its limits; they afford us an insight into the material construction of the solar system, or even into that of the immeasurable universe.

"The meteorites have also been of great importance in the history of civilization, for there can hardly be a doubt that they first made man acquainted with the use of the metal which above all others has contributed to his progress. All iron of a terrestrial origin is combined with other substances, which conceal its true nature from the uninitiated eye, and from which it is with difficulty separated; but here it lies at our feet, like a pure gift from heaven, and requires nothing but softening by fire and hammering to assume at once a useful form. As the Esquimaux of Baffin's Bay, long before Captain Ross discovered them in their icy solitudes, had found out the method to forge implements of the chase out of meteoric iron, thus also in pre-historic times this extra-terranean substance furnished man with his first iron spear or his first iron axe."

Prophetic Astronomy. By Richard Sheward. Pp. 96. Price 2s. 6d. London, Charing Cross Publishing Company.

The author first gives his views of the physical interpretation of the first chapter of Genesis, beginning with the creation of matter in the form of gaseous atoms; from these the gradual formation of unshapen blocks and meteoric matter of vastly varying magnitudes, and in one region of space the merging together of all the meteoric matter into one ball, and then bursting forth in the glory of a sun (page 9).

Having explained how the greater light was made, he proceeds to account for the moon, of which he says, that there is clear evidence of its having been exposed to a fearful meteoric bombardment, so immense are the mountains here heaped upon its surface, so enormous the meteors that struck it, that as the meteor crushed itself to powder under the mighty force of its own delivered blow, the powdered matter spread laterally, forming a mountain ring, the interior of the ring like a vast amphitheatre with a mighty cone rising in the centre, for the crushed central portion of the meteor could not spread, but of necessity formed a cone (page 30).

The miracle in Joshua is explained by an enormous fragment of a meteoric stream striking the earth in a direction opposite to its rotary motion, which was thereby temporarily retarded (pages 33, 34).

Planets, supposed [erroneously] to be mentioned in 2 Kings, xxiii. 5. Comets and zodiacal lights are also discussed on the author's theory, which is next, together with copious Scriptural citations, brought to bear on the future. With great positiveness we are assured that 1,500 years must pass before the coming of the Lord (page 48); that the motion of the sun in space will be found (perhaps 20 or 30 years hence) to be

accelerative and direct, till at last the catastrophe is at hand; "the long journey of our sun is now approaching completion; the other suns that with ours have for thousands of years been hastening towards the common centre are at hand, ours and them moving towards each other with a force and velocity generated by their united gravity, and the vastness of the fall, rushing towards the centre at velocities of which the least may exceed 1,000,000, and the greatest possibly not under 4,000,000 miles per hour, the velocity of our own sun probably 2,000,000 or more miles per hour" (page 56). * * * "If I give a velocity of 2,000,000 miles per hour to the strange sun that will sweep past the earth, and possibly within 10,000,000 miles distance, I give a velocity that may possibly be exceeded one-half, yet at this velocity 24 hours, or just one rotation of the earth, is the whole time its surface will be exposed to the most blasting heat—quite sufficient time to burn up everything over which fire has power" (page 60).

After passing the centre, towards which our own sun, and other suns in connection with it are now hastening, each system will begin to revolve round the common centre of the whole; but this centre is itself also moving, and with accelerated motion, so that other centres and greater revolutions will subsequently be developed.

We regret to find that in the end the moon will be taken away from us by the greater attraction of some other system that approaches near enough for the purpose (page 80). But the author thinks it will not be missed, having done its work; for as there will be no more sea, and the earth will be ever receiving the light of several suns, there will be no further occasion for it.

We are frequently unable to understand or follow the dynamical and physical principles of Mr. Sheward, whose speculations would seem to bear him along with the speed of one of his own meteor streams. To himself, nevertheless, they are not speculations, but certainties, and he speaks with the authority of a prophet; "I appeal," he says, "to the astronomers of the future for justice, when the words I am writing are proved true, inasmuch as it does not appear possible for the acceleration to be proved in less than 20 years, and possibly it may be more, for upon the word acceleration I will base the truth of all I write. If the sun's motion is not accelerative, there is no truth in what I have written; if accelerative, and I fearlessly say it is, then the demonstration by me of the fact of the motion of the sun being accelerative 20 or 30 years before it can be found so, ought to exercise weight in the balance of judgment" (page 49).

Given such an acceleration, perhaps some of the author's glowing descriptions of future catastrophes might have a semblance of possibility. Any theory on such a subject should, nevertheless, not want in its presentation perspicuity of style, sobriety in treatment, and modesty in pretension. In these respects we find in this book room for improvement, especially in the last-mentioned quality. We feel after its perusal as though we had endured a rather severe "meteoric bombardment," whilst at the same time we respect the writer as an earnest and pious, and to a certain extent, ingenious person.

Books received.—"W. Huggins on the Spectrum of Coggia's Comet."—"Prophetic Astronomy." By R. Sheward. Charing Cross Publishing Company. 1874.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

SOLAR ECLIPSE.

Sir,—The writer of the article on the Solar Eclipse in the the *Times* of Tuesday, the 20th of April, endeavours to prove that the corona is a brilliant object, much brighter, area for area, than the moon. For this purpose he cites the fact that observers of total eclipses have repeatedly found themselves able to read with comfort during the period of totality; and he further states that a camera of say "four inches aperture will impress an image of the corona on a prepared plate in far less time than it will impress an image of the moon at its brightest."

As the question of the brightness of the corona is one of vital importance in the selection of methods of observation during future total eclipses, I shall not apologize for shortly stating the reasons which have led me to differ from the writer of the *Times'* articles on this point.

During a total eclipse the corona is not the only source of light to persons stationed within the cone of totality. The whole heavens are illuminated as is well-known by a faint violet light, which is sufficiently bright to shut out all stars below the third magnitude ; stars of the second magnitude, and a few of the third, are only seen with difficulty by observers who have a pretty accurate knowledge of where to look for them. Added to the general illumination from the heavens, the clouds upon the horizon shine with brilliant tints of red and yellow, and the illumination derived from all these sources is sufficient entirely to overpower the light of the corona, as is proved by the fact that observers have not been able to detect any shadow cast by it, although such a shadow has frequently been looked for. Halley, in the description of the total eclipse which he observed in London in 1715, says, "Nor was the light of the ring round the moon capable of effacing the lustre of the stars, for it was vastly inferior to that of the full moon, and so weak that I did not observe that it cast a shade." Since that time, Prof. Federow, at Tschernigow, in 1842, Mr. Swan and the Rev. Temple Chevallier, at, Gottenburg, in 1851, MM. Lespiault and Burat, at Briviesca, and Herr Cuillier, at Vitorea, in 1860, together with many others, have observed and registered that no shadow is cast by the corona. It is not therefore by light derived from this source that an observer is enabled to read during totality.

As to the second point cited in the *Times'* article in proof of the brightness of the corona, viz., that its light impresses itself on a photographic plate more rapidly than that of the full Moon. I think that on an examination of the facts, this assertion will not be pressed. The corona photographs of Lord Lindsay and Colonel Tennant were taken with various exposures of from five to twenty seconds. Negative number five of Colonel Tennant's series, which was exposed for five seconds, has only a small extension; the outer and fainter parts of the corona failed to make any impression on the plate, whereas a dense photograph of the Moon can be obtained with a similar instrument in less than a quarter of a second. In proof of this I will refer to the *Monthly Notices* of the Royal Astronomical Society, Vol. xxvi. p. 62, when some photographs of

the Moon, when partially eclipsed (and, therefore, not under the ordinary illumination of full moon), are stated to have been taken by Mr. Brothers in from one to two-tenths of a second, and this was with a longer focussed instrument than that with which the Indian corona photographs were obtained.

It must further be remembered that the bright line spectrum bears only a small proportion to the total light emitted and dispersed by the corona; its chief brightness being due (as is evident from the polariscopic results) to the background of continuous or solar spectrum, on which the bright lines are seen in the spectroscope. And if the total light of the corona so slowly impresses itself upon the photographic plate, it cannot be expected that the light corresponding to a single bright line, will leave any detectable trace during the few minutes of totality.

The extreme faintness of the coronal lines may be gathered from an observation by Commander Maclear, in 1871, he says,—"On two successive nights before the eclipse, with the six-inch refractor and direct-vision spectroscope of seven prisms, I was able to see plainly three lines in the spectrum of the Nebula in Orion; and yet with the same instrument, during totality, I was unable to detect any spectrum in any part of the corona."

No photographic trace has as yet been obtained of the Nebula of Orion; how much less, therefore, could one be expected from one of its bright lines, or from a bright line of the corona? It is hardly necessary for me to remark, that the above reasoning does not apply to the prominences, which are no doubt brighter, area for area, than the full moon, but we can obtain their spectrum at any time.

I am, sir, your obedient servant,

A. COWPER RANYARD.

SATURN.

Dear Sir,—I willingly comply with your request, that I should send you some information respecting the coming conjunctions of Japetus, the outer satellite of Saturn, with the planet, to the importance of observing which attention was called at the last meeting of the Royal Astronomical Society. For, though there may not be much chance of any reader of the *Astronomical Register* having the opportunity of observing any part of such rare phenomena, as the occultation of Japetus by the ring and ball of Saturn on May 24, or as the transit of the satellite across the planet's disk on July 2, some of your readers may be able to observe the conjunctions which occur later in the year, and they will probably like to learn something of what might be looked for on the earlier occasions by observers in favourable positions. And that they may do so in the clearest way, I shall trouble them to make some simple sketches. Let the disk of Saturn be represented by an ellipse, the semi-axes of which are 1·00 and 0·90 units (say inches), the outer rim of the ring by an ellipse, the semi-axes of which are 2·31 and 0·46, the northern portion being hidden by the ball, then Japetus will pass at or about 20h. Greenwich Sidereal Time through or near the following points (reckoning from the centre parallel to the axes of the ring):

May 23	...	5·07 west.	0·50 south.
24	...	0·25 „	0·16 north (hidden by the ball).
25	...	4·57 east.	0·81 „

July	1	...	5·18 east.	0·24 north.
	2	...	0·54 „	0·41 south (in front of the ball).
	3	...	4·10 west.	1·07 „

By joining which the track of the satellite and its most likely position at any hour may be found. The prediction of these places is, of course, liable to considerable uncertainty, because the observations, which would have allowed a closer prediction to be made, are wanting. The effect of the uncertainty is, that the true path of Japetus will be a little higher or lower than the predicted one, and that the satellite will pass any point of its journey perhaps a couple of hours earlier or later than is expected. If the request made on p. 181 of your last volume and some later private appeals had been successful, the uncertainty of the predictions might have been considerably diminished. It appears, however, from an estimate of Japetus, which M. Lassell has been good enough to make on November 3, that the uncertainty will not amount to many hours, and the Washington observations, communicated at the last meeting of the Royal Astronomical Society, though they leave the question unsettled, indicate at least no very great error. Supposing then the predicted positions of Japetus not to be far wrong, the satellite will be occulted by the ring close to the end of the preceding arm on May 24, at about 10h. Greenwich sidereal time, will some hours later possibly be visible again in the dark interval between the ring and ball, be occulted by the ball at about 16h., reappear on the north side of the following arm, and be in conjunction with the extreme point of the arm on May 25, at about 9h. Greenwich sidereal time, at a distance of half a semi-diameter of the ball. On July 2, at about 11h. Greenwich sidereal time, Japetus will be in conjunction with following edge of the ring on the southern side, will then travel for many hours along and upon the rim of the ring, be in conjunction with the centre of the disc at about 23h., with the preceding limb of the ball at 4h, and with the preceding edge of the ring on July 3, at about 11h., Greenwich sidereal time.

There are perhaps a score of existing telescopes which might be fit to secure the observations of at least a part of these phenomena, provided only they were erected in suitable localities in a pure and transparent atmosphere. The next chance of observing an occultation and a transit of Japetus will not occur till 1890.

About the conjunctions, which will take place later in this year, on August 11, September 18, October 29, and December 7, more another time.

Yours faithfully,

A. MARTH.

METEOR.

Sir,—A bright meteor was seen here on March 9, at 8h. 0m. It passed down the S.E. sky about 9° W. of Cor Hydræ. The observed part of its path was from R.A. 134°, D. 16°—, to R.A. 144°, D. 26°—. It was quite equal to Venus, but it was seen through much haze. There was no visible train. The motion was exceedingly slow; it occupied about 3s. in traversing its path of 16°. The meteor was probably one of the members of the radiant in Perseus A5, near α (No. 20 in Grey's list, *Monthly Notices* R.A.S., Vol. XXXII., p. 349), which supplies many of the meteors seen during the first half of March.

I am, Sir, your obedient servant,

Cotham Park, Bristol: WILLIAM F. DENNING.

March 15, 1875.

MAGNITUDES OF STARS.

Sir,—Perhaps the errors of atlases may have something to do with the variation of magnitudes mentioned by Mr. Gore, and not in every case an actual change in the brightness of the star itself. For instance, as to the two stars first mentioned by Mr. Gore in his letter of January 11, ν Orionis is marked mag. 5, the same as its neighbour ξ in maps of S.D.U.K., 1830. In the same maps there is a star south of ν Eridani, without any letter to it, but answering exactly to Mr. Gore's position, R.A. 2h. 35m., S.43½°. This is marked mag. 5.

I mentioned in the *Register* of April last that the more distant companion of ζ Orionis, classed by Smyth as mag. 10, is clearly visible with 2¼in., and hence not lower than mag. 8. There is a decided change in the lustre of μ Draconis, if Smyth and Webb were right in putting it down as mag. 4. To a communication I made to the R. A. S. on this subject lately, there was appended a note that Argelander classes the components of this star, as 4,5, which would be equal to 4·7, but a lower magnitude than this must be taken now. Dawes called both components 6. mag., and this combination would produce a star of about the present brightness of μ Draconis. Faithfully yours,

Upton-Helion's Rectory : S. J. JOHNSON, F.R.A.S.

March, 5, 1875.

OCCULTATION OF STARS

Sir,—It appears from your report of the monthly meeting of the Royal Astronomical Society, contained in the *Astronomical Register* for July last, that Mr. Dunkin pointed out that a great difficulty would be experienced in the identification of the stars in my occultation list read at that meeting. I may say that in recording each occultation in my observation book, I almost always accompanied it with a rough sketch of the phase observed, so that from the records I am enabled to furnish approximately the angles of disappearance from the moon's cusps. Considering, however, the copious catalogues now available to most astronomers for that region of the sky embraced between the declination limits of the moon's orbit, I thought that all the stars in the list which, with two or three exceptions, exceed the 9th magnitude, had been already observed, and could therefore be approximately laid down on a chart. Such being the case, the only doubt about identification would be when two or more stars were to be found on or very near the projected curve of the moon's quadrant. In turning each observation to account it would, of course, be necessary to determine the right ascension and declination of the moon's centre, as seen from the observatory at the instant of observation, and the star in the chart which falls on the quadrant described from the projected place of the centre, with a radius equal to the moon's apparent semi-diameter, might reasonably be, assumed as the one observed. These calculations, it will be seen, not only serve for the identification of the stars, but are also necessary for the determination of the corrections of the longitude, which is the object sought in the observations.

In communicating my list for 1874 I will give the estimated angles of position. In future observations I shall, however, be in a better position for fixing the plans of the occulted stars. JOHN TEBBUTT.

Private Observatory, Windsor, N. S. Wales :

January 14, 1875.

THE DOUBLE STAR γ DELPHINI.

Sir,—In the September number of the *Register*, I see Mr. Johnson speaks of the components of this star as equal. I find from my note-book that I observed this star with my 3-inch refractor on 3rd November, 1874. and noted that there was about 1 magnitude difference in lustre (about 4 and 5); colours, reddish yellow and greyish lilac. The companion is probably variable, as Webb says ("Celestial Objects," p. 241), "7 more like 6, 1865."

Your obedient servant,

Punjab, India: J. E. GORE.

February 3, 1875.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat. of the centre of the sun's disc.	Angle of position of sun's axis.	
	°	°	°	°	
May 1	126·31	+13·23	−3·97	335·71	+·19
2	139·54	·23	−3·87	335·90	·19
3	152·77	·24	3·77	336·09	·20
4	166·01	·23	3·66	336·29	·21
5	179·24	·24	3·56	336·50	·21
6	192·48	·24	3·45	336·71	·22
7	205·72	·23	3·34	336·93	·23
8	218·95	·24	3·23	337·16	·23
9	232·19	13·24	−3·12	337·39	+·24
10	245·43	·24	3·01	337·63	·25
11	258·67	·24	2·90	337·88	·25
12	271·91	·24	2·79	338·13	·26
13	285·15	·24	2·67	338·39	·27
14	298·39	·25	2·56	338·66	·28
15	311·64	·24	2·45	338·94	·28
16	324·88	13·24	−2·33	339·22	+·28
17	338·12	·25	2·22	339·50	·30
18	351·37	·24	2·10	339·80	·30
19	4·61	·25	1·98	340·10	·31
20	17·86	·24	1·87	340·41	·31
21	31·10	·25	1·75	340·72	·32
22	44·35	·24	1·63	341·04	·32
23	57·59	13·25	−1·51	341·36	+·33
24	70·84	·25	1·40	341·69	·34
25	84·09	·25	1·28	342·03	·34
26	97·34	·24	1·16	342·37	·35
27	110·58	·25	1·04	342·72	·35
28	123·83	·25	0·92	343·07	·36
29	137·08	·25	0·80	343·43	·36
30	150·33	13·25	−0·68	343·79	+·37
31	163·58	·25	0·56	344·16	·38
June 1	176·83		0·44	344·54	

Assumed daily rate of rotation 14°·20.

A.M.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF MARS.

Greenwich Midnight. 1875.	Areographical longit.		latit. of the centre of ♂'s disk.	Angle of position of ♂'s axis.	Diameter.
	°	°	°	°	″
May 1	316·0	+350·7	−5·56	26·88	13·95
2	306·7	0·8	−5·60	26·78	14·10
3	297·5	0·7	5·64	26·68	14·26
4	288·2	0·8	5·67	26·59	14·42
5	279·0	0·7	5·70	26·50	14·58
6	269·7	0·8	5·72	26·42	14·74
7	260·5	0·8	5·73	26·35	14·90
8	251·3	0·7	5·74	26·28	15·07
9	242·0	350·8	−5·74	26·22	15·23
10	232·8	0·8	5·74	26·16	15·40
11	223·6	0·8	5·73	26·11	15·57
12	214·4	0·9	5·72	26·06	15·74
13	205·3	0·8	5·70	26·02	15·91
14	196·1	0·8	5·67	25·99	16·08
15	186·9	0·9	5·64	25·96	16·25
16	177·8	350·8	−5·60	25·94	16·43
17	168·6	0·9	5·56	25·93	16·60
18	159·5	0·9	5·51	25·92	16·78
19	150·4	0·9	5·45	25·92	16·95
20	141·3	0·9	5·39	25·93	17·13
21	132·2	0·9	5·32	25·94	17·30
22	123·1	0·9	5·24	25·96	17·48
23	114·0	351·0	−5·16	25·99	17·65
24	105·0	0·9	5·07	26·02	17·82
25	95·9	0·9	4·97	26·06	18·00
26	86·8	1·0	4·87	26·11	18·17
27	77·8	1·0	4·76	26·17	18·34
28	68·8	1·0	4·64	26·23	18·51
29	59·8	1·0	4·52	26·30	18·68
30	50·8	351·0	−4·40	26·38	18·84
31	41·8	1·0	4·27	26·46	19·00
June 1	32·8		4·13	26·55	19·16

To find the longitude of the central meridian for other hours, add to the longitude given in the table—

At 12	0 G.M.T.	0·0	At 14	0 G.M.T.	29·3
	10	2·4		10	31·7
	20	4·9		20	34·1
	30	7·3		30	36·6
	40	9·8		40	39·0
	50	12·2		50	41·4
13	0	14·6	15	0	43·9
	10	17·1		10	46·3
	20	19·5		20	48·8
	30	21·9		30	51·2
	40	24·4		40	53·6
	50	26·8		50	56·1
14	0	29·3	16	0	58·5

A. M.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m. Jupiter.
Sat	1	14	Uranus in quadrature with the Sun Saturn's Ring: Major axis=37″·24 Minor axis=7″·44			10 56·8
Sun	2	13	Conjunction of Moon and Venus, 0° 38′ S. Sun's Meridian Passage 3m. 7·16s. before Mean Noon	2nd Oc. D.	15 57	10 52·5
Mon	3		Sidereal Time at Mean Noon, 2h. 43m. 54·82s.			10 48·1
Tues	4	21	Conjunction of Moon and Mercury, 2° 52′ S.	2nd Tr. E. 2nd Sh. I. 2nd Tr. E. 2nd Sh. E. 1st Oc. D.	10 44 11 33 13 10 14 3 14 34	10 43·7
Wed	5	3 3	● New Moon	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	11 44 12 10 13 56 14 23	10 39·4
Thur	6	6	Conjunction of Saturn and μ Capricorni (5·5m.) W.	2nd Ec. R. 1st Oc. D. 1st Ec. R.	8 27 31 9 0 11 37 12	10 35·0
Fri	7			1st Tr. E. 1st Sh. E.	8 22 8 51	10 30·7
Sat	8	19	Superior conjunction of Mercury and Sun			10 26·3
Sun	9					10 22·0
Mon	10					10 17·6
Tues	11	19 36	☽ Moon's First Quarter	3rd Oc. R. 3rd Ec. D. 3rd Ec. R. 1st Tr. I. 1st Sh. I. 1st Tr. E.	8 43 8 58 27 10 59 32 12 59 14 7 15 26	10 13·3
Wed	12	11 7 11 44	Occultation of 37 Leonis (6) Reappearance of ditto	1st Tr. I. 1st Sh. I.	13 29 14 4	10 9·0
Thur	13			1st Oc. D. 2nd Ec. R. 1st Ec. R.	10 45 11 4 16 13 31 17	10 4·7
Fri	14			1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	7 56 8 33 10 8 10 46	10 0·4
Sat	15		Illuminated portion of disc of Venus=0·815 Illuminated portion of disc of Mars=0·950	1st Ec. R.	7 59 51	9 56·1

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
Sun	16	14 22	Saturn in quadrature with the Sun Conjunction of Moon and Jupiter, 2° 16′ N.			9 51·8
Mon	17		Sidereal Time at Mean Noon 3h. 39m. 6·62s.			9 47·5
Tues	18		Sun's Meridian Passage 3m. 48·30s. before Mean Noon	3rd Oc. D. 3rd Oc. R. 3rd Ec. D. 3rd Ec. R.	10 1 12 9 12 57 21 14 57 29	9 43·3
Wed	19	20 50	○ Full Moon			9 39·0
Thur	20	15 57 6	Near approach of α Scorpii Conjunction of Venus and *o* Piscium (2·4m.) W.	2nd Oc. D. 1st Oc. D. 2nd Ec. R.	9 42 12 30 13 41 12	9 34·8
Fri	21		Saturn's Ring: Major axis=38″·50 Minor axis=7″·49	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	9 42 10 28 11 54 12 41	9 30·5
Sat	22	11 20	Conjunction of Mars and λ Sagittarii (0·6m.) E. Conjunction of Moon and Mars 2° 53′ N.	2nd Sh. E. 1st Ec. R.	8 29 9 54 3	9 26·3
Sun	23					9 22·1
Mon	24					9 27·9
Tues	25			3rd Oc. D.	13 26	9 13·7
Wed	26	21	Conjunction of Moon and Saturn, 3° 0′ N.			9 9·5
Thur	27		☾ Moon's Last Quarter	2nd Oc. D. 1st Oc. D.	12 3 14 17	9 5·3
Fri	28			1st Tr. I. 1st Sh. I. 1st Tr. E.	11 30 12 23 13 42	9 1·1
Sat	29			2nd Tr. E. 2nd Sh. E. 1st Ec. R.	9 12 11 3 11 48 21	8 57·0
Sun	30	13 59	Occult. reappearance of 73 Piscium (6½)	1st Tr. E. 1st Sh. E.	8 9 9 4	8 52·8
Mon	31	14 30	Occult. reappearance of B.A.C. 609 (6)			8 48·7
JUNE Tues	1	10	Conjunction of Moon and Venus 4° 12′ S.			8 44·5

THE PLANETS FOR MAY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	2 7 40	N.11 45	5″·0	23 27·8
	9th	3 4 47	N.17 28	5″·0	* *
	17th	4 15 20	N.22 41	5″·4	0 36·1
	25th	5 22 34	N.25 19	6″·0	1 11·7
Venus ...	1st	0 20 3	N. 0 24	13″·8	21 40·5
	9th	0 55 11	N. 3 58½	13″·2	21 44·1
	17th	1 30 41	N. 7 31	12″·6	21 48·0
	25th	2 6 50	N.10 55½	12″·2	21 52·6
Mars ...	1st	18 12 50	S. 24 22	16″·6	15 34·2
	9th	18 18 0	S. 24 44	18″·2	15 7·9
	17th	18 20 5	S. 25 11	19″·8	14 38·5
	25th	18 18 45	S. 25 42	21″·4	14 5·8
Jupiter ...	1st	13 34 40	S. 8 15½	41″·4	10 56·8
	9th	13 31 15	S. 7 57	41″·0	10 22·0
	17th	13 28 16	S. 7 41	40″·4	9 47·5
	25th	13 25 49	S. 7 28	39″·8	9 13·7
Saturn ...	1st	21 51 3	S. 14 12	14″·9	19 11·9
	9th	21 52 37	S. 14 5½	15″·1	18 42·0
	17th	21 53 48	S. 14 6	15″·4	18 11·7
	25th	21 54 35	S. 13 58	15″·6	17 41·0
Uranus ...	1st	8 55 37	N.18 4	4″·0	6 18·5
	17th	8 56 48	N.17 58½	4″·0	5 16·8

Mercury is close to the sun at the beginning of the month. In the middle of the month he may be seen 45 minutes after sunset, the interval increasing to two hours on the last day.

Venus may be observed for a short time in the morning, the interval varying from 50 minutes before sunrise to 1h. 7m. on the last day.

Mars rises shortly before midnight on the 1st, the interval increasing to nearly two hours by the end of the month.

Jupiter is a brilliant object throughout the night, till a quarter of an hour before sunrise at the beginning of the month. He sets an hour and a half before sunrise on the last day.

Saturn rises two hours before the sun on the 1st, the interval increasing. He is still too low for satisfactory observation.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MAY, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXIII. British Association map, 55° to 60° N. latitude.

Mare Humboldtianum (B) (*a*) 10°, Endymion (27) the north part; Warren De la Rue (434) (*b*) 7½°, Gärtner (37) (*c*). The portion of this zone stretching from 35° west longitude to 40° east longitude is occupied by the western and eastern divisions of the Mare Frigoris (C) broken by the following craters: Mrs. Somerville (431) in 22° west longitude, Miss Sheepshanks (432) in 16° west longitude, Mrs. Ward (433) in 7° west longitude, Archytas (46) (*d*). From 3° to 6° east longitude, north-west

of Plato is a fault not unlike "Straight Wall," it is marked δ by B. and M., and, like "Straight Wall," separates tracts of different levels in the Mare Frigoris. From 30° to 40° east longitude Herschel II. (412) south border (*e*), Horrebow (175) at the south-east corner of the border in 40° east longitude. In 75° east longitude we find Xenophanes (178) and Cleostratus (179).

(*a*) See Webb's "Celestial Objects," third edition, p. 86, where the remarkable flattening of the moon's limb in the neighbourhood of the Mare is mentioned. For B. and M.'s description of the Mare see "Der Mond," pp. 208 and 209.

(*b*) This is a large walled depression north of Endymion. The region is figured in T XLII. of Schröter's "Fragments."

(*c*) Gärtner is described by Schröter in his "Fragments," vol. II., pp. 214, 215, § 785 and figured in T LXII., fig. 1.

(*d*) The three craters Timæus (170) in zone XXV. Archytas and Mrs. Ward are shown by Schröter in TT XXI. and LXI., where they are respectively indicated by the letters D, E, and F. In his "Fragments," § 764, vol. II., p. 199, Schröter designated D by the name "Timæus," and E and F by Archytas. There appears to be some confusion in the nomenclature hereabout.

(*e*) On the south of the border of Herschel II., in the Mare Imbrium, are two unnamed craters, marked by B. and M. B in 30° east longitude, and *f* in 35° east longitude.

CICHUS and its neighbourhood. We are in possession of *nine* drawings, ranging from 1791 to 1875, in addition to B. and M. and Lohrmann's maps. From a careful comparison of these drawings, we find within and close upon the boundary included, by a line joining the craters Mercator, Capuanus and Cichus, as many as twenty-nine craterlets. Space prevents us particularizing them, but we shall be glad to receive drawings and notes of the region for comparison with those in our possession, and to elucidate a monogram of the district.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF JUPITER.

1875.	Longit. of ♃'s meridian turned to the earth at 8h.	10h.	12h.	Angle of position of ♃'s axis. 12h.	Annual parallax. 12h.	Latitude of earth above ♃'s equator.	Latitude of sun above ♃'s equator.
	°	°	°	°	°	°	°
May 1	166·0	238·6	311·1	22·81	+2·96	−3·13	−2·93
2	316·7	29·3	101·8	22·84	+3·16	−3·13	−2·93
3	107·4	180·0	252·5	22·86	3·35	3·12	−2·94
4	258·1	330·7	43·2	22·88	3·54	3·12	
5	48·8	121·4	193·9	22·90	3·73	3·11	
6	199·5	272·0	344·6	22·92	3·92	3·11	
7	350·2	62·7	135·3	22·94	4·11	3·10	
8	140·8	213·4	286·0	22·96	4·29	3·10	
9	291·5	4·1	76·6	22·98	+4·47	−3·09	−2·94
10	82·2	154·7	227·3	23·00	4·65	3·08	
11	232·9	305·4	18·0	23·02	4·83	3·08	
12	23·5	96·1	168·6	23·04	5·01	3·07	

13	174·2	246·8	319·3	23·06	5·19	3·07	—2·94
14	324·9	37·4	110.0	23·08	5·36	3·06	—2·95
15	115·5	188·1	260·6	23·10	5·53	3·05	
—							
16	266·4	338·8	51·3	23·12	+5·70	—3·05	—2·95
17	56·8	129·4	201·9	23·13	5·87	3·04	
18	207·5	280·0	352·6	23·14	6·04	3·04	
19	358·1	70·7	143·2	23·16	6·21	3·03	
20	148·7	221·3	294·9	23·17	6·37	3·03	
21	299·4	11·9	84·5	23·19	6·53	3·02	
22	90·0	162·6	235·1	23·20	6·68	3·02	—2·95
—							
23	240·6	313·2	25·7	23·21	+6·83	—3·01	—2·96
24	31·3	103·8	176·4	23·23	6·98	3·01	
25	181·9	254·4	327·0	23·24	7·13	3·00	
26	332·5	45·1	117·6	23·25	7·27	3·00	
27	123·1	195·7	268·2	23·26	7·41	2·99	
28	273·7	346·3	58·8	23·27	7·55	2·99	
29	64·3	136·9	209·4	23·28	7·68	2·98	
—							
30	214·9	287·5	0·0	23·29	+7·81	—2·97	—2·96
31	5·5	78·1	150·6	23·30	7·94	2·97	
June 1	156·1	228·7	301·2	23·31	8·07	2·96	

A.M

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Feb., 1875.

Matthews, W. P.

To Mar., 1875.

Elger, T. G. E.
Heelis, J.
Parkes, Rev. J.
Vines, D.

To April, 1875.

Vallack, Rev. B.

To June, 1875.

Baron, Rev. J.
Elliott, R.
Lancaster. J. L.
Lancaster, W. L.
Wathereston, A. J. W.

To Dec., 1875.

Dansken, J.
Perry, Rev. S. J.

To Mar., 1876.

Herschel, Captain J.

To June, 1876.

Worthington, F.

TO CORRESPONDENTS.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

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The pages of the *Astronomical Register* are open to all suitable communications, Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON. *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 150. JUNE. 1875.

ROYAL ASTRONOMICAL SOCIETY.

Session 1875—76.

Third Meeting of the Session, May 14th, 1875.

Lord Lindsay, M.P., *Vice-President,* in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

The minutes of the last meeting were read and confirmed.

Mr. Ranyard announced that forty-six presents had been received by the Society since their last meeting in March. The thanks of the Society were voted to the donors.

The following candidates for the Fellowship of the Society were balloted for and duly elected:

Henry Martyn Taylor, Esq., M.A., Fellow and Tutor of Trinity College, Cambridge.

Percy Lyall Hooker Davis, Esq., Computor in the *Nautical Almanack* Office.

Silvanus Phillips Thompson, B.A. (London), St. Mary's, York.

Capt. Charles Orde Browne, late Royal Artillery, Plumstead House, Plumstead.

Mr. Dunkin said: I am glad to be able to report that several of the gentlemen whose names were read at the last meeting, as being in arrear with their subscriptions, have paid them, and that in this manner 100 guineas have been added to the funds of the Society since the last meeting. There now only remain three Fellows who have not paid up, namely—

Mr. Jabez Moden,
Mr. W. J. H. Beechey, and
Mr. W. Hislop.

It will be the duty of the Chairman now to declare these gentlemen expelled from the Society.

Lord Lindsay: It is my unpleasant duty to declare these three gentlemen, Mr. Moden, Mr. Beechey, and Mr. Hislop, to be expelled from the Society for the non-payment of their arrears. I regret that the painful task should devolve upon me, and more especially as this is the first time that I have had the honour of presiding over a meeting of a learned society.

Mr. Dunkin said that Mr. A. C. Russell, the Government Astronomer at Sydney, was present with a valuable series of photographs, which he would exhibit to the meeting, and he was sure that the representatives of astronomical science in England would appreciate Mr. Russell's labours, and would be pleased with the opportunity of seeing the photographs. They had been taken on glass and were very delicate. It would be impossible to have them handed round, but Mr. Russell would explain them afterwards to any one desiring to examine them. Mr. Russell, however, had some drawings which he would hand round for inspection.

Mr. Russell said: He hardly knew how to compress his observations into a few words. He had begun by impressing upon his observers, of whom he had about thirteen, that they were not to go to their observations with any preconceived ideas, but were to record, as far as possible, exactly what they saw; they did not all observe the same phenomena. The great majority of the observers did not see any indication of the black drop; they had all practised beforehand with an artificial transit, similar to the one at Greenwich; he himself did not see the black drop, but a few seconds before internal contact a sort of vibratory motion occurred between the limb of the planet and the sun. As soon as the contact had taken place a haziness came over the junction of the two, not blotting out the cusps, but as if a piece of black wool was laid over the cusps. Soon after this a ring of light was seen by nearly all the observers round the planet's limb, it was a fine brilliant line of light around the part of the planet's limb off the sun. It was estimated at less than one second of arc in breadth by most of the observers. Several of the photographic plates showed a very delicate line of silver edging the planet, and some of the observers saw outside the part of the limb that was on the sun, to the extent of half the diameter of the planet, a ring of light or halo, very much like that described by Mr. Huggins and Mr. Stone, as seen by them during the transit of Mercury in 1868. This appearance distinctly showed itself round the planet in the photographs on the sun's disc as an extra deposit of silver. He could not see any explanation of this, unless it was that the light immediately around Venus was more actinic than on the sun's disc generally. He would have been prepared for an increase in the deposit of

silver over the body of the planet, but this was on the sun's limb, outside from the limb of the planet. He had several drawings of this appearance. At first he was inclined to accept the explanation offered by Mr. Stone, that it was the effect, simply, of contrast, but he did not now think he could accept that explanation.

With reference to the length of the black drop, one of the observers who saw it distinctly had the impression conveyed to him that the length was nearly a semi-diameter of the planet. This observer was adjusting the photo-heliograph when he saw it. He had the centre of the plate ready to begin, and he turned the handle of the Janssen apparatus, and obtained 60 pictures immediately afterwards, but not one of them showed any indication of the black drop. The line of sunlight separating the planet from the sun was perfectly sharp and hard, and, what was perhaps more remarkable still, it was only $\frac{1}{20}$th of the diameter of the planet, or three seconds in arc across, whereas the conviction of the observer was that the black drop was some 30 seconds in arc long. Another observer who saw the black drop, as he thought, had estimated the length also at about a semi-diameter of the planet. The photographs, however, proved the exact length in seconds over which the black drop was seen. It was a remarkable fact bearing on the optical deception (though he did not say that the black drop was only an optical deception) that the photographs taken immediately after the ligament was seen to form proved that it could not be more than $\frac{1}{20}$th of a diameter of the planet long. One remarkable feature was observed with reference to the ring or thread of light, which appeared to be less than a second of arc in diameter. The other halo or bright band round the planet could not be measured, but appeared to be about $\frac{1}{5}$th of the diameter of the planet broad. In the ring of light round the part of the limb of the planet off the disc, about the position of the pole of the planet, there was an enlargement, or sort of spot; he himself saw it distinctly, and it was seen by several others. One gentleman who saw nothing of the ring saw the spot of light at the pole, and a great many saw the enlargement of the ring, and one observer saw it at a station 2,200 feet above the level of the sea, when using a $4\frac{1}{2}$-inch equatorially mounted telescope, with an atmosphere so clear that the sun's limb was perfectly sharp; he saw the ring of light and the enlargement of the pole, and had made a great number of drawings representing what he saw. The ring of light was manifestly brighter than the limb of the sun, and at the moment of internal contact it appeared to the observer that the dark band which ought to have connected the planet and the sun's limb on contact

was cut in two by a brilliant line of white light, while the rest of the sun's surface appeared a pale yellow. This the observer had represented in a great number of drawings, and had explained his drawings by notes made at the time. Several of the observers' drawings appeared to give the planet a globular appearance, but to himself it appeared a perfectly flat disc. He should be glad to hear any explanation of these facts. The photographs he would also be glad to show, but they required a bright light and great care in order to see them. In addition to those he had brought, he had about 250 more which he could not conveniently carry. At Sydney they obtained 180 photographs, at the station on the mountains, 63 whole pictures of the sun, and 10 Janssen plates; at the southern stations, 43 pictures of the sun before it became cloudy, and they lost the last contact. He had also some photographs of the observing parties which might be interesting. (Hear, hear.)

Mr. Stone, being called on by the Chairman, said: He had already informed the Society in a paper of what had been seen of the transit at the Cape of Good Hope. Knowing that the station at the Cape was not one of primary importance for the determination of the sun's parallax, he determined to use rather a bright field; he considered that a great mistake had been made in not settling some standard of brightness for eye observations. If the black drop had anything to do with irradiation it depended on the brightness of the field; and to expect that a number of people with fields of different degrees of brightness and different instruments should see anything like the same thing was to him incredible. What he saw with a rather bright field was simply this:—As Venus drew near to the sun's limb he saw a very fine line, almost like a cobweb pass between Venus and the sun: this, at first, was a little tremulous and very faint, but gradually as Venus drew nearer to the limb it became, comparatively speaking, broad, and the planet assumed something like an egg-shape, and then, after waiting some time, he made out the light beyond the curvature. The first time he saw any trace of this line Venus was about a second and a half from the sun's limb. He had a power of 220. First he saw a fine cobwebby appearance, which gradually broadened, and ultimately he made up his mind that the contact had taken place. He had no means of taking photographs, but there were some photographs taken, and the one where Venus was on the limb the disc of the planet was certainly longer in the direction of the sun's centre than in the others. He could not lay any great stress on these photographs for the purpose of measurement. But they showed that Venus was round on the

sun's disc and elongated when in contact with the limb. And this did away with the subjective character of the phenomenon. With regard to people not seeing the black drop, he could have avoided seeing it himself if he had used a sufficiently dark glass.

Mr. Dunkin: Still you are perfectly certain you did see it?

Mr. Stone: Yes, and you will find one or two of the others saw it as well.

The Chairman: The smaller the telescope the easier you would see the ligament; were you using the 6-inch?

Mr. Stone: No, the 7-inch.

Captain Noble: Do you attribute this wholly to irradiation or partly to diffraction?

Mr. Stone: I look upon diffraction as a part of irradiation. I divested myself of all bias, and I certainly saw the appearance during the time I am speaking of, and when I now look at the photographs I see the same thing in the photographs.

Mr. Ranyard said: He had been exceedingly interested in hearing Mr. Russell's explanation of the physical phenomena attending the transit. He was glad to find that the Australian photographs so distinctly showed that the part of Venus which was visible outside the sun's limb was seen by reason of a thread of light surrounding it, and not by reason of contrast between the brightness of the dark limb of Venus and the surrounding area. There appeared to be little doubt that this line was due to the refraction of the sun's rays within the atmosphere of Venus. The brighter spot which had been mentioned by Mr. Russell as being near to the pole of Venus was certainly very interesting; it had been noticed by so many independent observers that there could, apparently, be very little doubt about it. He would like to suggest that possibly we had in this little spot of brighter light a very delicate indication of the greater refractive power of the atmosphere of Venus in the cold regions near to its pole, producing a further extension of the twilight or dawn which was visible to us as the bright line.

As to the other bright line which surrounded the part of Venus that was on the sun's disc, he thought that this was not due to anything connected with the atmosphere of Venus. A similar line was visible round the moon's limb in partial eclipses, and was distinctly to be traced on all partial phase photographs. He would not then enter into what he believed to be the true explanation of the brightening of the photographs. There was a great deal of literature on the subject. The Astronomer-Royal, Professor Stephen Alexander, Dr. Curtis, and many others had inquired into the matter, and written papers on their experiments. There could be no doubt of the existence of such a

bright line or band in the eclipse photographs, and he had no doubt that the bright band round the body of Venus or the sun was due to a similar cause.

Mr. De la Rue: When I observed the artificial transit at Greenwich, I saw no black drop at all, when the four-inch telescope was in perfect focus, but with a smaller instrument I did see it. I am entirely of opinion that the black drop is a subjective phenomenon depending partly on the corrections of the telescope, partly on the accuracy with which it is brought into focus, partly on the state of the atmosphere, and partly on the eye of the observer. The eye of the observer, the eye piece, the object glass, all constitute one instrument, the conditions of which must be taken into account in dealing with a phenomenon of this kind. I am very gratified to find that the photographs, taken with the instruments which were calculated to produce an image as accurate as possible, showed no black drop. The experiments recorded by Mr. Russell are very crucial, they show that through the finder of the instrument, which was probably not calculated to give a perfect image, the long black drop was seen, but in the photograph a wide space is found existing between the limbs of the sun and the planet. What better proof can we have that in that particular case the phenomenon was purely subjective? I cannot but congratulate Mr. Russell upon the very great success with which he has carried out his operations, knowing that the instruments barely reached him in time, and yet he has the largest number of photographs of any observer. This brings me, as I am now on my legs, to the controversy I have seen in the papers, but in which I have not taken part, as to the relative advantages of the daguerreotype, the collodion processes and the American long-focus, and the photo-heliograph process.

Now, I wish it to be understood that I am answerable for the photo-heliograph process, and for its adoption by England our colonies and Russia, and I venture to opine that, notwithstanding all the remarks made by advocates of other systems, when the results come to be worked out they will vie in accuracy with anything yet obtained; I found this opinion on some measurements I made in 1860 of the sun's disc, I worked out its position with regard to the moon's centre and very curious results I obtained, and I know they are to be depended upon. In a paper read by Mr. Proctor at the last meeting, he ventures to state that the distance of the sun's centre from Venus's centre cannot be determined so well with the photo-heliograph process, where the image was magnified by a second magnifier, as by other methods. Now, first of all, admitting that the photographed image of the sun may be enlarged by this instrument in

consequence of irradiation, and Venus's diameter diminished (which I don't believe will be found to be the case), yet the measurements may be obtained as accurately with regard to the distances of the centres as if no irradiation had taken place. [Mr. De la Rue then drew upon the black board in illustration of his argument].

Captain Noble said he thought Mr. De la Rue had not quite apprehended one of Mr. Proctor's points; which was not only the inapplicability of the photo-heliograph to the measurement of the distances between the centres of Venus and the sun, when measured on the photographed solar diameter, in the absence of a trustworthy scale, but also its inapplicability to the proper registration of the time of two contacts, external or internal. Mr. Proctor, as he understood him, meant that if they photographed an internal contact and exposed it for a long time they would have a large sun and a little Venus, and if they exposed the plate a short time then they would get a small sun and a big Venus. Mr. Proctor's second point, therefore, was that the difference of exposure would make all the difference as to where Venus would appear with regard to the sun's limb.

Mr. De la Rue said that it appeared to him that what had been written and published had been lost sight of. If any one had read his paper on his measurements of the eclipse pictures of 1860, it would be found that he had made an attempt to trace back from the observations he then made, of the distances of the centres of the sun and moon on a series of photographs to the time of the first and last contact, and if any one would refer to the paper they would see that he obtained the results with very great accuracy, and that, notwithstanding all the changes of over-exposure and under-exposure, he showed by how much the tabular diameters of the sun and moon taken together were too large, and he believed that, with the several series of photographs of Venus on the sun's disc, by taking the angle of position and the distance they would be able to trace back to within a very small fraction of a second the undoubted time of contact. He was perfectly certain that, properly dealt with, photography would give most accurate results. The American method had been very much praised, and objection had been taken to the photo-heliographs on account of the optical distortion, but they could easily deal with optical distortion, as he had been dealing with it with the Kew photo-heliograph, and he found he got numbers which enabled him to get the necessary correction, but it was not so easy to deal with the correction of the plane mirror of a siderostat, which to begin with might not be a real plane, and would most certainly on account of varying flexture not remain one.

He did not wish to disparage the American method, which had been also adopted by Lord Lindsay, because he thought the problem should be attacked in every possible way, and the praising of one method need not necessarily lead to the disparagement of the other. Then with regard to the processes, the daguerreotype and the collodion, he was one of the first in England to work with the daguerreotype, but now he gave the preference to the collodion process for astronomical work.

Mr. Stone: Is there not a difficulty in correcting for unknown amounts of refraction?

Mr. De la Rue: I suppose the position of the sun will be taken into account and the necessary correction applied.

Mr. Stone said: No doubt the correction could be applied, but its accuracy would be problematical. He should be glad to know if Mr. De la Rue had considered the effects of Janssen's observations. After having observed the contact at ingress he obtained photographs in which the contact had apparently not taken place, showing that this phenomenon was not subjective, for the contact lasted over a considerable time.

Mr. De la Rue said it would be seen at all events that he had not lost sight of the corrections for optical distortion, and that these corrections could be so made as to result apparently in no distortion having occurred.

Mr. Hunter said that in the artificial model at Greenwich he never could see the black drop so well as some others; but when observing the transit with a double-image micrometer, he saw a line suddenly connect the two limbs, and the length of the line as he estimates it was from 5 to 7 seconds. It was particularly sharp and clear. He was not going to say what it was due to, but he had no hesitation in saying that he saw the line there, and it remained perfectly visible for some seconds. The air was not very steady, but it gradually grew darker, and very shortly after it first appeared a certain amount of shadow began to extend on each side of it on the sun's limb, until at the time of contact there was a pear-shaped form about Venus herself. The instrument he used was a 4 and 6-10ths aperture.

Capt. Abney said that in photographing the model transit no trace had ever been obtained of the black drop.

Lord Lindsay: Under certain conditions I think you can photograph it.

Capt. Abney: In the photographs taken in Egypt there is no appearance of the black drop.

Lord Lindsay: I have not seen it in any of the photographs of the transit, but with the artificial transit I was able to produce a very large one. [Lord Lindsay showed some photographs in

which the black drop was very marked. They had been taken at his laboratory before starting.] In these the model Venus was $\frac{5}{100}$ths of an inch from the limb of the sun, and by giving a longer exposure than would be advisable with the sun, the ligament can be obtained very marked. I think I see Mr. Burton here from Rodriguez. Perhaps he would give us some account of his observations.

Mr. Burton: In one of the Janssen photographs taken at Rodriguez a connection between the limbs does appear and there is also to be seen a slight change in the density of the deposit of silver near the planet's limb. But the ligament properly so-called does not appear to my eye. The photographs I have no doubt will be produced hereafter.

Capt. Abney: The photographs—[those shown by Lord Lindsay]—appear to me not to be the black drop, but irradiation from over exposure; the enlargement, as it were, of the sun's limb through irradiation.

Lord Lindsay: I think the idea is that the black drop is always caused by irradiation (laughter).

Capt. Abney: If it be subjective, of course it would not be represented in the photograph.

Mr. Ranyard: By irradiation you mean the enlargement of a bright object.

Capt. Abney: An enlargement of the sun's diameter.

Mr. Ranyard: Such as would be caused by each point of the object being represented by a patch of small area in the photograph.

Capt. Abney: Yes; the photograph might be accounted for in that way. It is very hard indeed to photograph a line which is only 1-500th of an inch in diameter.

Mr. Russell, in reply, said he had not expected to raise a discussion. He had merely stated what had occurred to the Australian observers. Of the two observers out of 13 who saw the black drop, one was using a non-achromatic glass, of 4-inches aperture, and the other a $3\frac{1}{2}$-inch achromatic telescope, stopped down, and was observing over the roofs of houses (laughter). He had hoped that something might have been elicited with regard to the constitution of the ring of light halo. He did not think any atmosphere about the planet could account for the ring of light which he had described and others had seen in other parts of the world. Gentlemen would be aware that any atmosphere would refract the light and disperse it between the planet and the earth, and it would not appear as the brilliant line described, nor could it, having passed through the refracting medium, retain a sufficiently active power to photograph itself on a photographic

plate. With respect to the other halo having been produced artificially, he was not prepared to give a decided opinion, but he could not see any reason why the silver should be deposited on the sun's limb round the planet, more thickly than in other places. One idea had occurred to him. Of all objects Venus was the most difficult to see in a telescope. It was practically almost impossible to get a sharp definition of it, and it appeared as if it had some light of its own in fact added to the sunlight, which would produce an additional deposit of silver. This was the only explanation he could see at present.

Mr. Ranyard did not suppose that the light of the sun was refracted, so as to form the bright line round the planet, but that the light was reflected from clouds or dispersed within the atmosphere of Venus. And as to the bright band around the part of the limb of the planet on the sun, he thougnt it hardly necessary to assume that there was anything different in Venus from what there was at the moon's limb, for they had the same bright line seen apparently with the naked eye as well as on the photographs in every partial eclipse of the sun.

Lord Lindsay: Does Mr. Russell find this bright line exterior to the sun's disc appear to belong to a circle of larger diameter than the dark body of Venus *on* the sun?

Mr. Russell: It appears to complete a circle of Venus on the sky.

Lord Lindsay: The two arcs appear to match one another?

Mr. Russell: Yes; but it requires a particular light to see it. 1-500th of an inch on a photograph is a very fine line to see.

Mr. Huggins: Is it equally bright all round, or is it more distinct at one limb than at the other?

Mr. Russell: In the great majority of the photographs it is equally bright all round, but on some of them it extends only partially round, from one of the cusps half the way round. It seems to me that the line must be caused by light reflected by some translucent matter. I don't think it can be caused by refraction.

Lord Lindsay asked whether the halo interfered with the measurement of the cusps?

Mr. Hunter said that it did not interfere with the measurement of the cusps. The light was a clear light, something similar to that of the planet, but not at all like sunlight. So far as he could judge it was light reflected from the surface or atmosphere of Venus. The two were perfectly distinct the one from the other, and did not interfere with the measurement of the planet.

Mr. Christie read a paper *On the determination of the scale in*

photographs of the transit of Venus. He said there was one important point of practical objection to the photo-heliographic method which had not been touched upon, and that was, not the measure of the distance between the centres of the sun and the planet, but the determination of the scale by which these measurements would be referred to seconds of arc. That was the real point at issue, and was the really difficult thing to determine. He had drawn out in his paper what appeared to him to be the best available method of determining it. This question of the scale was considered at an early stage. They had a method of accurately determining the irradiation, so that the photographs might be treated just as if there were no irradiation. The question of the black drop, as far as he had seen the Janssen plates, would hardly enter into it. To get as accurate results from measures of focal length as from this method, it would be necessary to find the distance of the photographic plate from the optical centre of the forty-feet telescope within one-twentieth of an inch of the south. The real difficulty in determining the focal length was to find the optical centre of the object-glass in combination with the plane mirror. The centring in this case of the lenses was one of the most difficult things that opticians had to deal with.

Lord Lindsay thought the optical centre could be obtained by calculation from the curvature of the lenses and the density of the glass.

Mr. Christie: Yes, the usual rule was one-third of the thickness; you could determine the centre of a spherical surface, but when they come to a surface nearly plane it was impossible for opticians to answer for the truth of the centre.

Mr. De la Rue said that some time ago he made special preparations with the view of determining the scale of the micrometer, with which the sun had to be measured. He placed a scale on the Pagoda at Kew, having alternate plates and spaces exactly one standard foot, and the photographs of it enabled him to determine the angular value and the irradiation.

Mr. Christie said this point of Mr. De la Rue was of great importance, but there was yet the question whether the instruments might not have suffered some change since the observations were made.

Mr. De la Rue said any change of that kind could be easily ascertained if photographs of the scale were obtained before starting and after the return of the expeditions.

Mr. Ranyard said, it must be remembered that with the photoheliograph the photographs were taken in what he might call the *tertiary* or third focus; there were two lenses between the photographic plate and the principal focus of the instrument, and

there was, he understood, no means of registering the exact position of these two lenses.

The following papers were laid before the Society and partly read:—

A note from Mr. Proctor, *on his Paper on Photography in the Transit of Venus*

· Mr. H. L. Spindler: *Memoranda of Observations on the Transit of Venus, December 9th,* 1874, communicated by Mr. Stone.

J. M. Wilson: *On the period of the Double Star η Coronæ Borealis,* communicated by the author.

Professor C. Piazzi Smyth: *Note on the proper motion of the Star in Cetus, marked* 793 *in the British Association Catalogue,* communicated by the author.

Dr. Gyldén: *Right Ascensions of* 103 *Fundamental Stars,* (abstracted by Mr. Wackerbarth) communicated by Mr. Wackerbarth.

M. O. Struve: *Observations and Orbit of the Double Star,* Σ 1728=42 *Comæ Berenices,* communicated by the author.

E. Dunkin: *On the proper motion of B. A. C.* 793, communicated by the author.

Colonel Tennant: *On the Dimensions of Venus as determined during the recent Transit,* communicated by the author.

George Knott: *On the Star* 61 *Geminorum,* communicated by the author.

SKY-LIGHT.

I have endeavoured to show you that the colour and polarisation of the sky could be reproduced artificially, and that the only condition necessary to their production was the smallness of the particles by which the light was scattered. The effects were proved to be totally independent of the optical character of the substances from which the particles were derived. The parallelism of the artificial and the natural phenomena is so perfect as to leave no doubt upon the mind that they are due to a common cause. And here a practical issue of immense import reveals itself. Supposing those particles which now throw down upon us the blue light of the firmament to be abolished, what would be the result? The sun's rays would pass through the atmosphere without lateral scattering—the earth would lose the light of the sky. To form an idea of the magnitude of this loss, we must have a clear idea of the *quality* of the light under consideration. It is now known to you that the vegetable world is nourished by the rays of the sun; and as animal life is sustained by vegetables, that life is also supported in the long run by the solar rays. Now, these rays are as composite as the coins of the realm. As regards their power to produce the chemical actions necessary to vegetable life, they differ from each other in value as widely as gold does from copper. It is the gold of the solar beams that is showered down upon us from the sky. Professor Roscoe has shown that the light of the sky, which is mainly produced by the shorter waves, has a chemical

value at Kew Observatory, greater than that of the unclouded sun at a height of 42° above the horizon.* This would be the measure of the loss to the vegetable world at Kew if the sky were abolished. Roscoe's experiments were made with chemical substances sensitive to solar light, and they appear open to the objection that the rays effective in the plant-world may not be those which were effective upon his salts. But taking everything into account, and assuming the correctness of his observations, I think the probability great that the value of sky-light as a feeder of the vegetable world, and through it of the animal, cannot be much less than Roscoe makes it to be.—*From Tyndall's "Heat a Mode of Motion,"* pp. 541-42.

THEORY OF COMETS.

"I may now add (1870) that cometary envelopes and various other appearances may be accurately reproduced through the agency of cyclonic movements introduced by heat among actinic nebulæ [clouds]. It is needless to say that this hypothesis also accounts for the polarisation of the light of the comet's tail."—*Tyndall.*†

REVIEW.

Nouvelle Méthode pour déterminer la Latitude d'une station au moyen d'observations Azimutales. Par François Diaz Covarrubias, Sous-Secrétaire du Ministère des Travaux Publics au Mexique, et Président de l'Expédition envoyée en Asie par le Gouvernement Mexicain pour observer le passage de Vénus. Yokohama. Imprimerie et Libraire de "L'Echo du Japon," 1874. (pp. 15).

This method is designed to avoid the uncertainties in the measurement of vertical angles arising from the flexure of the telescope, refraction, the deformation of vertical circles by reason of weight, &c. A little preliminary analysis shows the advantage of employing a star which shall have at the same time a considerable azimuth, and a small zenith distance; to fulfil which conditions stars should be selected whose declinations do not differ much from the latitude of the place. Observing these at a small distance from the meridian, results will always be obtained nearly independent of small errors of observation. The author proceeds to explain the method of proceeding without knowing the meridian reading (N.) of the azimuth circle, and the error of the chronometer. To determine the latitude thus, the star must be observed at the same altitude on both sides of the meridian. Formulæ follow for instrumental corrections, and the case when the zenith distances are not exactly equal; and equations formed by which h, the star's hour angle,—the error of the chronometer—and a, the azimuth (reckoned from the earth), are obtained. The latitude is then calculated from a well-known formula. It is to be observed as to the values of h and a, that they possess the

* Proceedings of the Royal Institution, vol. iv. p. 657. The whole article here referred to is exceedingly interesting.

† There may be comets whose vapour is undecomposable by the sun, or which, if decomposed, is not precipitated. This view opens out the possibility of invisible comets wandering through space, perhaps sweeping over the earth and affecting its sanitary condition without our being otherwise conscious of their passage. As regards tensity, I entertain a strong persuasion that out of a few ounces (the possible weight assigned by Sir John Herschel to certain comets) of iodide-of-allyl vapour an actinic cloud of the magnitude and luminousness of Donati's comet might be manufactured—p. 552. (See *Astronomical Register*, vol. vii., 180.)

essential advantage of being expressed in junction of the differences of the instrumental indication, and are in consequence independent of the constant errors of the instruments, and of the observer.

The author next shows how to prepare for the observation, *i.e.*, to place the instrument in position, and to find the hour of the observation, using the known approximate latitude. Having selected a star that culminates near the zenith, and whose position is well-known, it is to be kept bisected by the vertical wire before its meridian passage, by means of the tangent-screw of the azimuth circle, the motion of which is to be stopped when the star traverses the horizontal wire; the telescope having been previously fixed beforehand at the suitable altitude. The time is then noted, and the readings of the vertical and horizontal circles and levels taken. The only use of the vertical circle reading is in the case when several observations of the same star are made, at different altitudes, in order to place the telescope in corresponding positions on the other side of the meridian; which serves besides to calculate the approximate value of the zenith distance for correction of the azimuth for the horizontal error of the axis. The star is observed in the same manner after its meridian passage. Lastly, the author, having collected and arranged the different formulæ in their order of use, applies them to an example, worked out in full. The last application of the method was in the City of Mexico; the stars observed being β Arietis, and ϵ Tauri, which culminate there at a short distance from the zenith. The assumed latitude was $19° 26'$. On January 23rd, 1872, an observation of ϵ Tauri, east and west of meridian gave latitude $19° 26' 7{\cdot}9''$. Five observations of this star, the same night, between $3°$ and $15°$ of zenith dist. gave as mean results, error of the time + 1m. 23·47s, lat. $19° 26' 7{\cdot}52''$. In order to exhibit the agreement of the individual results by this method, a table is given of the observations in the city of Mexico. These were not always made under the best possible conditions; for the altazimuth had not yet been firmly fixed on the marble slab which crowns the massive stone pier on which it was placed later, and this circumstance probably caused occasional slight azimuthal movements, in spite of the great weight of the instrument. 1. Series. Star β Arietis. It appears from the table that a mean of 16 observations in 8 days of December, 1871, and of 2 on December 30th, 1872, gave lat. $-7{\cdot}93''$. 2. Series. Star ϵ Tauri, a mean of 22 observations on 6 days of January, 1872, gave lat $-7{\cdot}54''$. To appreciate the precision of these results, the probable errors from given formulæ of a single observation in the first series is $\pm\ 0{\cdot}83''$, and the probable error of the mean result is $\pm\ 0{\cdot}20''$. For the second series, the probable error of a single observation is $\pm\ 0{\cdot}70''$ of mean result, $\pm\ 0{\cdot}19''$. Taking the result of each series in inverse ratio of the square of its probable error, we find $19° 26' 7{\cdot}7''$ for the latitude according to the above observations. The author remarks, "These figures show the perfect agreement which may be obtained by careful working, and I propose to employ this method of determining the latitude in combination with others in common use, at the station where I am going to observe the transit of Venus. If the new method is favourably received by astronomers, I will venture to claim for it the name of the *Mexican method.*"

The MS. of the above was prepared by the author in the Pacific, on board of the English Steamer "Vasco de Gama," on which he had embarked for his station in Asia. It was printed in Japan, in order that other foreign observers, who would probably be found there, might read it. We have given an outline of the contents of the pamphlet, which we should be glad to see translated and published in this country. As

far as we are competent to judge, the method deserves to rank with others well-known; such as that with the zenith telescope, the transit instrument in the Prime Vertical, and the double passage of circumpolar stars. It seems to have some strong points of its own; and besides its use in fixed observatories, might be well suited sometimes to nautical surveyors and scientific travellers. We rejoice that Mexico has taken part in the observations of the transit of Venus, and possesses an astronomer of the ability of M. Covarrubias. We shall be glad to hear more of his labours.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER.

Observers of Jupiter in 1874 were struck with the disappearance of No. 2 belt, which for some years previous was the most marked feature on the planet. It has now reappeared, and though I cannot say that it is complete, it is certainly to some extent nearly, if not quite, as dark as formerly. No. 5 belt, next the equatorial region on the south, is as dark as 2, and has separated from 4, with which it coalesced last year. Above it I can see traces of several belts, but very indistinctly. The equatorial region seems broken up with white and dark spaces, but the regular range of black spots, divided by the bright festoons that used to hang from 4 belt toward the equator, no longer appears. I find, however, that the constantly bad atmosphere, and the increased southern declination, make Jupiter an unusually difficult object this year, and prevent me from having much confidence in my observations.

The colours on the disc are very striking.

Millbrook, Tuam: J. BIRMINGHAM.
May 14, 1875.

METEORS, &c.

Sir,—On March 16th. at 8h. 23m., I was startled by a bright light from behind me, and on turning round was just in time to see the disappearance of what must have been a fine meteor. When I saw it, it was about the size of Sirius, but had been far brighter. It rose perpendicularly over either β or δ Leonis. I think the former.

On the 17th, about 9h., another bright meteor was seen here, but I have received no details of it.

On April 22nd, at 11h. 19m., I saw a very beautiful one in the extreme east of Virgo, falling about 4° on each side of the equator from Corona, and though the new moon was shining a few degrees from it, the meteor formed a distinct orange ring or corona in the light cloud in front of it. It was of a lovely pale green hue, with a train of sparks, and though of no apparent size was considerably more brilliant than Venus.

Another meteor of a red colour and of short duration, brighter than Jupiter, was seen in the S.W. about 25° from the horizon, on May 6th at 7h. 55m.

Although we are supposed to be near a sun-spot minimum, yet every fortnight large spots have come round in several different places during the past four months. Is not this a rather irregular proceeding?

Yours truly,
H. CORDER.

Writtle, near Chelmsford:
May 8, 1875.

THE DOUBLE STAR 17 HYDRÆ.

Sir,—The Rev. T. W. Webb (Celestial Objects, p. 234) gives the components of this star as 5·5, 7, 1833, and says "7 var.? only ½ in difference, 1852." I examined this star a few nights since with a 3-inch refractor and found the components nearly equal, the *s. p.* stars (Webb's 7m.) being rather the larger of the two. Sir J. Herschel in 1835 rated them both equal 6m., and made the *s. p.* star his primary.

Your obedient Servant,
J. E. GORE.

Punjab, India:
April 5th, 1875.

MIRA CETI.

Sir,—It may interest some of your readers to learn that Mira attained its maximum this year on the 25th February, being then about equal in lustre to *a* Ceti. Its next maximum is, therefore, due on or about the 23rd January, 1876.

Your obedient servant,
J. E. GORE, A.I.C.E.

"DESCRIPTIVE ASTRONOMY."

Sir,—I am preparing for publication next year a new edition of my "Descriptive Astronomy." A book of this character must necessarily have many general defects, and contain a certain number of errors. Allow me to notify to the astronomical world through your columns that I am prepared to welcome suggestions and corrigenda from any and every quarter.

I am, sir, your obedient servant,
GEORGE F. CHAMBERS.

East Bourne, Sussex:
April 10, 1875.

THE ZODIACAL LIGHT.

Arago considered it was established beyond a doubt that the intensity of the zodiacal light varied in a small number of years. Last January the weather was generally unfavourable for observing it.

January 31.—Zodiacal light conspicuous θ and η Ceti outside the light, also γ in Pegasus; ω, ι, γ Piscium within, but not in the densest part.

February 4.—Not so clearly defined as the Milky Way and not so white. Up to η Piscium it was pretty distinct, and though very faint afterwards, could be traced over the four stars τ^1 τ^2 ζ δ Arietis.

February 5.—Zodiacal light duller than the aurora and without any flickering, much denser than the Milky Way at low altitudes, because it overpowered the stars to some extent. Arago's statement that "the light does not prevent us perceiving the smallest stars upon which it is projected" is utterly untrue, at any rate, in such winters as the two past.

February 22.—Very brilliant.

March 9.—Brighter than I have noticed it this winter. The moon was situated to-night at a point where the axis of the light would pass, and being 2½ days old, rendered it almost invisible while she remained above the horizon. γ Arietis was within the boundary and possibly β; α seemed outside. It could clearly be traced up to the Pleiades to-night, if not beyond them.

It was perceptible, though generally faint, on the 10th, 27th, 28th.

Thus, though the light has not been quite so conspicuous as in the early months of 1874, when I forwarded some notes of it to the *Register*, it has well deserved attention.

Childrey, who first makes mention of it in modern times, in a book published in 1661, says that "in the month of February for several years about six o'clock in the evening, after twilight, he saw a path of light tending from the twilight towards the Pleiades. This is to be seen, whenever the weather is clear, but best when the moon does not shine. I believe this phenomenon has been formerly and will always hereafter appear at the above-mentioned time of the year. But the cause and nature of it I cannot guess at, and therefore leave it to the enquiry of posterity." He suspects this is what the ancients call trabes. Pliny, lib. II., says, "Emicant Trabes quos docos vocant." On April 3rd, 1707, Derham in Essex says it appeared about a quarter of an hour after the sun set, in the form of a pyramid. The base of this pyramid he judged to be the sun. It was thought of a dusky red colour, at first pretty vivid and strong, but faintest at the top. The light must have been intensely vivid to show itself only a quarter of an hour after sunset. I have never been able to perceive it till stars of the 3rd and 4th magnitudes became visible.

M. Arago devotes several pages to the subject. He quotes Nicephorus to show that this species of light was noticed by the ancients. Nicephorus relates that after Rome was taken by Alaric there was a great eclipse, and a light was seen in the heavens in the form of a cone. The The eclipse referred to is really not that which took place at the capture of Rome in A.D. 410, but one eight years afterwards, almost total at Constantinople, when a cone-shaped light was seen in the sky according to Philostorgius, the second time a comet first became visible under such circumstances.

S. J. JOHNSON.

Upton-Helion's Rectory,
Crediton, April 30.

Erratum.—Vol. xiii. p. 99: List for April, line 5, for *Delne* read *Deluc*

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JUNE, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXIV. British Association map, 55° to 60° S. latitude.

Fifteen degrees from the moon's western limb Hanno (382) the west border, 5° Pontécoulant (381) the west border 20° Hagecius (391) 4° from the east border of Hagecius Nearchus (390). Between the east border of Nearchus and the west border of Jacobi (395) in longitude 12½° west are several unnamed craters: 2° further east Zach (396). Between Zach and Clavius (193) in 8° east longitude is a region which has received the name of "Terra Photographica" (448). It extends south and north from Cysatus (264) in Zone XXVIII. to Maginus (195) in Zone XXII., the south parts being in Zone XXVI., the middle in Zone XXIV., and the north in Zone XXII. (*a*) The north part of Clavius stretches over about 12° of longitude eastwards of which is Scheiner (261.) Ten degrees further eastward of Clavius is Rost (236), and about five degrees further east Weigel (249). Between Rost and Weigel is an unnamed crater about the size of Rost. The forty-fifth meridian east longitude passes through Segner (248) eastward of which is the large walled plain Rosse (417).

(*a*) On the western boundaries of "Terra Photographica" is Deluc (194) the north part of which is in Zone XXII. The most favorable time for observing the objects west of "Terra Photographica" is from the 4th to the 11th of June inclusive; after the latter date the altitude of the moon decreases rapidly.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF MARS.

Greenwich Midnight. 1875.	Areographical longit. of the centre of ♂'s disk.		Areographical latit. of the centre of ♂'s disk.	Angle of position of ♂'s axis.	Diameter.
	°	°	°	°	"
June 1	32·8	+351·0	−4·13	26·55	19·16
2	23·8	1·1	3·98	26·66	19·32
3	14·9	1·0	3·83	26·77	19·48
4	5·9	1·1	3·67	26·88	19·63
5	357·0	1·0	3·51	27·00	19·77
6	348·0	351·1	−3·34	27·12	19·91
7	339·1	1·1	3·17	27·24	20·05
8	330·2	1·1	3·00	27·37	20·19
9	321·3	1·1	2·82	27·50	20·32
10	312·4	1·1	2·64	27·64	20·44
11	303·5	1·1	2·46	27·78	20·56
12	294·6	1·1	2·27	27·93	20·67
13	285·7	351·1	−2·08	28·08	20·78
14	276·8	1·1	1·89	28·24	20·88
15	267·9	1·1	1·70	28·40	20·97
16	259·0	1·2	1·50	28·56	21·06
17	250·2	1·2	1·30	28·72	21·14
18	241·4	1·1	1·10	28·88	21·21
19	232·5	1·1	0·90	29·04	21·27

20	223·6	351·2	−0·70	29·20	21·33
21	214·8	1·1	0·51	29·37	21·38
22	205·9	1·2	0·32	29·54	21·43
23	197·1	1·	−0·13	29·71	21·47
24	188·2	1·	+0·06	29·87	21·49
25	179·3	1·2	0·25	30·03	21·51
26	170·5	1·1	0·43	30·19	21·52
—					
27	161·6	351·2	−0·61	30·35	21·53
28	152·8	1·1	0·79	30·50	21·53
29	143·9	1·1	0·97	30·65	21·52
30	135·0	1·2	1·14	30·80	21·50
July 1	126·2		1·31	30·95	21·48

June 7. Autumnal equinox for ♂'s northern hemisphere.

A.M.

EPHEMERIS OF THE SATELLITES OF SATURN.

At 20h. Greenwich Sidereal Time.

The apparent distances of Titan and Japetus and the rectangular co-ordinates of the three inner satellites are expressed in semi-diameters of the planet's equator.

+ x East of minor axis of ring. + y North of major axis of ring.
− x West " " " − y South " " "

	Tethys.		Dione.		Rhea.		Titan.		Japetus.	
June	x	y	x	y	x	y	pos.	dist.	pos.	dist
20	+2·9	+0·8	+2·2	+1·2	+4·7	+1·5	314·4	6·1	89·0	48·7
21	−3·5	−0·7	+3·1	−1·1	+8·3	−0·6	48·0	5·2	89·1	45·8
22	+4·1	+0·6	−6·2	+0·3	−1·7	−1·7	79·4	11·7	89·2	42·6
23	−4·5	−0·4	+5·2	+0·7	−8·9	0·0	88·5	17·3	89·2	39·2
24	+4·8	+0·2	−0·6	−1·3	−1·6	+1·7	93·7	20·5	89·3	35·5
25	−5·0	−0·1	−4·4	+0·9	+8·4	+0·6	98·0	20·9	89·4	31·6
26	+5·0	−0·1	+6·4	+0·1	+4·6	−1·5	102·8	18·3	89·6	27·5
—										
27	−4·8	+0·3	−4·0	−1·0	−6·7	−1·2	110·4	13·4	89·8	24·3
28	+4·5	−0·4	−1·1	+1·2	−7·0	+1·1	130·0	7·2	90·1	18·9
29	−4·0	+0·6	+5·5	−0·7	+4·1	+1·6	211·2	4·6	90·6	14·4
30	+3·4	−0·7	−6·1	−0·4	+8·5	−0·5	255·0	10·2	91·5	9·8
July										
1	−2·7	+0·8	+2·6	+1·2	−1·0	−1·8	266·5	15·9	94·0	5·2
2	+1·9	−0·9	+2·7	−1·2	−8·9	−0·1	272·5	19·5	134·0	0·7
3	−1·0	+1·0	−6·2	+0·4	−2·2	+1·7	277·2	20·2	262·0	4·2

Conjunction of the satellites with the centre of the planet.

Gr. Sid. Time.	h.		y
June 20	15·6	Tethys	+1·0
	16·3	Dione	+1·3
21	10·0	Titan	+3·8
22	16·7	Rhea	−1·8
24	19·1	Dione	−1·3
	23·0	Rhea	+1·8

Gr. Sid Time.	h.		y
June 28	21·8	Dione	+1·3
29	14·2	Titan	−4·1
July 1	15·7	Dione	+1·3
	18·0	Rhea	−1·8
2 ?	11	Japetus incog. with full edge	−0·2
	22·8	Tethys	−1·0

A. M.

ASTRONOMICAL OCCURRENCES FOR JUNE, 1875.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	1	10	Conjunction of Moon and Venus 4° 12′ S. Sidereal Time at Mean Noon, 4h. 38m. 14·98s.			α Libræ 10 4·1
Wed	2		Sun's Meridian Passage 2m. 21·23s. before Mean Noon			10 0·1
Thur	3	10 20 15	● New Moon Conjunction of Mercury and ε Geminorum (8·8m.) E.			9 56·2
Fri	4			1st Tr. I.	13 18	9 52·3
Sat	5	2	Conjunction of Moon and Mercury, 3° 14′ S.	1st Oc. D. 3rd Sh. I. 2nd Sh. I. 2nd Tr. E. 3rd Sh. E.	10 32 10 38 11 6 11 33 12 51	9 48·3
Sun	6			1st Tr. E. 1st Sh. E.	9 58 10 59	9 44·4
Mon	7			1st Ec. R. 2nd Ec. R.	8 11 20 8 14 41	9 40·5
Tues	8					Moon. 4 35·6
Wed	9					5 23·1
Thur	10	7 55	☽ Moon's First Quarter Saturn's Ring: Major axis=39″·82 Minor axis=7″·73			6 6·7
Fri	11					6 47·8
Sat	12			3rd Tr. I. 2nd Tr. I. 1st Oc. D. 3rd Tr. E.	10 7 11 26 12 21 12 28	7 27·8
Sun	13	1	Conjunction of Moon and Jupiter, 2° 10′ N.	1st Tr. I. 1st Sh. I. 1st Tr. E. 1st Sh. E.	9 35 10 42 11 48 12 54	8 8·0
Mon	14			1st Ec. R. 2nd Ec. R.	10 5 48 10 52 0	8 49·4
Tues	15		Illuminated portion of disc of Venus=0·890 Illuminated portion of disc of Mars=0·999			9 33·1
Wed	16	5	Conjunction of Mercury and δ Geminorum (4·6m.) W. Sidereal Time at Mean Noon 5h. 37m. 23·36s.			10 19·5

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage
		h. m.			h. m. s.	h. m.
Thur	17		Sun's Meridian Passage 0m. 31·09s. after Mean Noon			11 8·8
Fri	18	11 55 15	○ Full Moon Conjunction of Moon and Mars 0° 57′ N.			12 0·6
Sat	19	20	Opposition of Mars and Sun			Mars. — 12 2·8
Sun	20			1st Tr. I. 1st Sh. I.	11 27 12 37	11 57·5
Mon	21			2nd Oc. D. 1st Oc. D. 1st Ec. R.	8 35 8 39 12 0 19	11 52·2
Tues	22	14 46 16 5	Occultation of ι Capricorni (4½) Reappearance of ditto	1st Sh. E.	9 19	11 46·8
Wed	23	3	Conjunction of Moon and Saturn, 2° 41′ N.	3rd Ec. D. 3rd Ec. R.	8 52 19 10 58	11 41·5
Thur	24					11 36·2
Fri	25	12	Conjunction of Saturn and μ Capricorni (7·4m.) W.			11 30·9
Sat	26	2 39	☾ Moon's Last Quarter			11 25·5
Sun	27					11 20·2
Mon	28			1st Oc. D. 2nd Oc. D.	10 31 11 7	11 14·9
Tues	29	14 19	Conjunction of Mars and 3 Sagittarii (0·3m.) W. Conjunction of Mars and 3 Sagittarii 0·0	1st Sh. I. 1st Tr. E. 1st Sh. E.	9 1 10 0 11 14	11 9·6
Wed	30		Saturn's Ring: Major axis=41″·04 Minor axis=8″·14	1st Ec. R. 2nd Oc. R. 2nd Sh. E.	8 23 31 10 2 10 37	11 4·4
JULY Thur	1	4	Conjunction of Moon and Venus, 5° 21′ S.			10 59·2

THE PLANETS FOR JUNE.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	6 12 9	N.25 32½	6″·8	1 33·6
	9th	6 54 30	N.24 10½	7″·9	1 44·4
	17th	7 19 2	N.21 57	9″·5	1 37·4
	25th	7 23 26	N.19 43	11″·0	1 10·4
Venus ...	1st	2 39 11	N.13 43	11″·8	21 57·3
	9th	3 17 9	N.16 36½	11″·5	22 3·7
	17th	3 56 17	N.19 5	11″·2	22 11·3
	25th	4 36 33	N.21 2	11″·0	22 20·1
Mars ...	1st	18 14 41	S. 26 11½	22″·8	13 34·2
	9th	18 6 57	S. 26 46	24″·2	12 55·0
	17th	17 56 48	S. 27 16	25″·0	12 13·5
	25th	17 45 36	S. 27 39	25″·6	11 30·9
Jupiter ...	1st	13 24 12	S. 7 20½	39″·3	8 44·5
	9th	13 22 58	S. 7 15	38″·5	8 11·9
	17th	13 22 28	S. 7 14½	37″·5	7 39·9
	25th	13 22 39	S. 7 18	36″·7	7 8·6
Saturn ...	1st	21 54 57	S. 13 57½	15″·8	17 13·9
	9th	21 54 59	S. 13 59	16″·0	16 42·4
	17th	21 54 38	S. 14 2½	16″·2	16 10·6
	25th	21 53 52	S. 14 8	16″·4	15 38·4
Uranus ...	2nd	8 58 49	N.17 50	4″·0	21 16·0

Mercury is well situated for observation at the beginning of the month, setting 2h. after the sun, the interval gradually decreasing.

Venus rises rather more than hour before the sun on the 1st, the interval slowly increasing.

Mars may be seen 1h. 15m. after sunset at the beginning of the month, the interval decreasing. At the end of the month he rises before sunset.

Jupiter sets 2h. after midnight, at the beginning of the month, the interval decreasing to 15m. after midnight by the 30th.

Saturn rises at about midnight, on the 1st day, and then gradually earlier each night. On the last day he rises an hour and a half before midnight.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF JUPITER.

1875.	Longit. of ♃'s meridian turned to the earth at 8h.	10h.	12h.	Angle of position of ♃'s axis. 12h.	Annual parallax. 12h.	Latitude of earth above ♃'s equator.	Latitude of sun above ♃'s equator.
	°	°	°	°	°	°	°
June 1	156·1	228·7	301·2	23·31	+8·07	—2·96	—2·96
2	306·7	19·3	91·8	·32	8·20	·96	2·97
3	97 3	169·8	242·4	·33	8·32	·95	
4	247·9	320·4	33·0	·34	8·44	·95	
5	38·5	110·0	183·6	·35	8·56	·94	

6	189·1	261·6	334·2	23·35	+8·67	−2·94	−2·97
7	339·6	52·2	124·7	·36	8·78	·93	
8	130·2	202·7	275·3	·36	8·88	·93	
9	280.8	353·3	65·9	·37	8·98	·92	
10	71·3	143·8	216·4	·37	9·08	·92	
11	221·8	294·4	7·0	·37	9·18	·91	
12	12·4	85.0	157·5	·38	9·28	·90	−2·97
13	163·0	235·5	308.1	23·38	+9·37	−2·90	−2·98
14	313·5	26·1	98·6	·38	9·46	·89	
15	104·1	176·6	249.2	·38	9·55	·89	
16	254·6	327·2	39·7	·38	9·64	·88	
17	45·1	117·7	190.2	·38	9·72	·88	
18	195·7	268·2	340·8	·38	9·80	·88	
19	346·2	58·7	131·3	·37	9·88	·87	
20	136·7	209·3	281·8	23·39	+9·95	−2·87	−2·98
21	287·2	359·8	72·3	·39	10·02	·86	
22	77·8	150·3	222·9	·38	10·08	·86	−2·98
23	228·3	300·8	13·4	·38	10·14	·86	−2·99
24	18·8	91·3	163·9	·38	10·20	·85	
25	169·3	241·8	314·4	·38	10·26	·85	
26	319·8	32·3	104·9	·37	10·31	·84	
27	110·3	182·8	255·4	23·37	+10·36	−2·84	2·99
28	260·8	333·3	45·9	·36	10·41	·84	
29	51·3	123·8	196·4	·36	10·46	·83	
30	201·8	274·3	346·9	23·35	10·50	−2·83	−2·99

A. MARTH.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		lat.	Angle of position of sun's axis.	
	°	°	°	°	
June 1	176·83	+13·25	−0·44	344·54	+·38
2	190·08	·25	0·31	344·92	·38
3	203·33	·25	0·19	345·30	·39
4	216·58	·25	−0·07	345·69	·39
5	229·83	·25	+0.05	346·08	·40
6	243·08	13·25	+0·17	346·48	+·40
7	256·33	·25	0·29	346·88	·41
8	269·58	·25	0·41	347·29	·41
9	282·83	·26	0·53	347·70	·41
10	296·09	·25	0·65	348·11	·42
11	309·34	·25	0·77	348·53	·42
12	322·59	·25	0·89	348·95	·42
13	335·84	13·25	+1·01	349·37	+·43
14	349·09	·26	1·13	349·80	·43

15	2·35	·25	1·25	350·23	−·43
16	15·60	·26	1·37	350·66	·44
17	28·86	·25	1·48	351·10	·44
18	42·11	·25	1·60	351·54	·44
19	55·36	·25	1·72	351·98	·44
—					
20	68·61	13·25	+1·84	352·42	+·45
21	81·86	·26	1·95	352·87	·44
22	95·12	·25	2·07	353·31	·45
23	108·37	·25	2·18	353·76	·45
24	121·62	·26	2·30	354·21	·45
25	134·88	·25	2·41	354·66	·46
26	148·13	·25	2·52	355·12	·45
—					
27	161·38	13·25	+2·64	355·57	+·46
28	174·63	·25	2·75	356·03	·45
29	187·88	·26	2·86	356·48	·46
30	201·14		2·97	356·94	A.M.

Erratum.—No. 148, page 103, for *Opposition of Saturn* read *Opposition of Jupiter.*

Books received.—"Nouvelle Méthode pour determiner la Latitude, par François Diaz Covarrubias." Yokohama, 1874.

G. J. Symon's "British Rainfall, 1874." London: Edward Stanford, 1875.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1874.	To June, 1875.	To Dec., 1875.
Grover, C.	Bates, Rev. J. C.	Baxendall, J.
Jackson, O. C.	Lawton, W.	
	Wright, Rev. W. H.	

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. Jackson, *Clarence Road*, *Clapton*, *E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 151. JULY. 1875.

THE ROYAL OBSERVATORY.

The annual Visitation of the Royal Observatory, Greenwich, took place on Saturday, June 5, 1875, when the Astronomer-Royal presented his (the fortieth) Report to the Board of Visitors. The numerous invitations that had been issued to noblemen and gentlemen interested in the progress of astronomy were well responded to, the result being the usual gathering of the most distinguished of cultivators of the science. The report of Sir George Airy claims, however, our first attention, and in introducing the subject matter to our readers, we most cordially congratulate the Astronomer-Royal on the completion of the fortieth year of his Presidency of an establishment founded for, and which has contributed in the greatest degree to, the present efficient state of astronomy, as applied to navigation.

The Report of 1875 is drawn up in the same explicit manner which has characterised the former reports of the Astronomer-Royal. We have marked a few passages that in our opinion claim the attention of astronomers, whether professional or amateur.

Under the heading "Library," speaking of additions by presents from foreign countries, Sir George Airy alludes to the publication of unreduced meteorological observations, in the utmost detail, and doubts if the value of the library is much increased by such works. We may say, *en passant,* who will ever reduce this *cumulus* of meteorology? Turning to another part of the report, numerous as the meteorological observations registered by photography must be at Greenwich, we find that the Astronomer-Royal has selected twenty years' records of the dry and wet

thermometers for discussion, which he has arranged in hourly photographic readings, and grouped them by months, by high and low temperature, by high and low barometers, by clear and cloudy skies, and by directions of the wind. We await with much interest the publication of the abstracts of these groupings, which are just ready for the press.

The astronomical instruments are in a satisfactory state. In consequence of intolerable derangements of the water clock of the great equatorial, arising from the want of a supply independent of that obtained by a pipe 80 feet long, connected with the Observatory main, a cistern has been constructed in the Ball Turret, by means of which the performance of the clock has been most satisfactory.

The number of observations from 1874, May, 15, to 1875, May 20, is as follows: Transits, 3780; Circle observations, 3636; Altazimuth observations, 1517.

Under the head of Spectroscopic and Photographic observations we find that the spectrum of Coggia's comet was examined at every available opportunity last July, and compared directly with that of carbon dioxide, the bands of the two spectra being sensibly coincident. Decided polarisation in a plane passing through the sun was found in the coma as well as in the tail of the comet, a double image prism being used for this observation. Also that of the photographs of the sun taken with the Kew photo-heliograph on 186 days, 377 have been selected for preservation, the areas of spots having been measured to photograph 334 on, 1874, July 17. The moon, Jupiter, Saturn, and several stars, including the Pleiades, and some double stars, have been photographed with the great equatorial, with fairly satisfactory results. The carefully constructed scale of equal parts, 15 feet in length, employed by Mr. De la Rue in Kew Park for examination of photographic distortion, has been suspended at the north-east angle of the Octagon Room. The photographic hut of station A (Egypt) has been placed in the grounds of that school, by permission of the Superintendent of the Royal Naval School, for photographic examination of the scale.

The following interesting statement occurs relative to the Magnetic Basement: "Its walls have in the course of years become sensibly warmer, and the general temperature of the room has slightly risen. The magnetic elements are as follow: 1874, mean westerly declination, 19° 29′. Mean horizontal force 3·892 English units. Mean dip, 67° 45′ by 3-inch needles. There were only five disturbed days in 1874."

In the spring of the present year, 1875, seventy-three chronometers were placed in the Royal Observatory for trial, the object

being the selection of twenty-two for the Arctic Expedition. Previous to sailing the officers received instructions in the use of the transit and other astronomical instruments. In his report of chronometers, the Astronomer-Royal speaks of a supplemental mechanism introduced by him into some chronometers. Having long remarked that in ordinary good chronometers, the freedom from irregularities depending upon mechanical causes is most remarkable, but that, after all the efforts of the most judicious makers, there is in nearly every case a perceptible defect of thermal compensation, and considering the great difficulty in correcting the residual fault, not only because an inconceivably small movement of the weight on the balance-curve is required, but also because it endangers the equilibrium of the balance, the Astronomer-Royal introduced small supplementary weights, carried by means of a supplementary bar (rotating with stiff friction on the balance-staff) at whose ends are very light springs carrying the supplementary weights, and constantly pressing them to the interior of the balance-curve. When the supplementary bar is so turned that the supplementary weights are near the end of the balance-curve, the compensation is large; when they are near the root of the balance-curve, it is small. The movement from one state to the other is so simple that probably an assistant of the Observatory will be able to manage it, and it does not interfere with equilibrium.

The Greenwich and Deal time-balls, as well as the general system of time-signals, have been maintained in their general efficient states. The system of time signals continues to spread, and appears to be now a valuable national institution. The principal galvanic operation of the year in the transmission of time-signals is that connected with the Egyptian stations for observing the transit of Venus. For the determination of the longitude of Captain Orde Browne's observatory on the Mokattim Hills, two intermediate stations between Greenwich and Mokattim were chosen, viz., Porth Curno, in Cornwall, and Alexandria, in Egypt. In the actual operation, Mr. Ellis at Porth Curno received signals from Greenwich and sent signals to Alexandria; Mr. Hunter received them at Alexandria and sent signals to Mokattim, and communications were thus made both ways, between Greenwich and Mokattim on the same night, four sets of signals being exchanged. In the report on extraneous work, we have the following: "There has been little annoyance from the dreaded 'black drop.' Greater inconvenience and doubt have been caused by an unexpected luminous ring round Venus."

From the concluding "General Remarks," we quote the following: "The Observatory was expressly built for the aid of

astronomy and navigation, for promoting methods of determining longitude at sea, and (as the circumstances that led to its foundation show) more especially for determination of the moon's motions. All these imply, as a first step, the formation of accurate catalogues of stars, and the determination of the fundamental elements of the solar system. These objects have been steadily pursued from the foundation of the Observatory; in one way by Flamsteed, in another way by Halley, and by Bradley in the earlier part of his career; in a third form by Bradley in his later years, by Maskelyne (who contributed most powerfully both to lunar and to chronometric nautical astronomy) and for a time by Pond; then with improved instruments by Pond, and by myself for some years, and subsequently with the instruments now in use. It has been invariably my own intention to maintain the principles of the long-established system in perfect integrity."

ROYAL ASTRONOMICAL SOCIETY.

Session 1875—76.

Last Meeting before the Long Vacation, June 11th, 1875.

Professor Adams, F.R.S., *President*, in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

The minutes of the preceding meeting were read and confirmed.

Mr. Ranyard stated that forty-five presents had been received by the Society since their last meeting, amongst which two ancient astronomical instruments, which had been presented to the Society by Mr. Lecky, were especially worthy of notice. There were also two very handsomely bound volumes called "Picturesque America," which had been given to the Society by Georgetown College, U. S. A. Lord Lindsay had also presented a valuable folio copy of Sacrobosco's tracts. The thanks of the Society were duly voted to the donors.

The following candidates for the Fellowship of the Society were balloted for and duly elected:

John Locke Lancaster, Esq., 25, Hamilton Terrace, St. John's Wood.

Francis Richard Wegg Prosser, Esq., M.A., Belmont, Herefordshire, and 84, Eccleston Square, London, S.W.

Charles Venceslas Zenger, Professor of Natural Philosophy, Polytechnic School, Prague.

Mr. Lecky was called upon by the President to explain the use of the two instruments which he had presented to the Society.

Mr. Lecky said: These instruments are, I fear, more curious

than useful. The smaller of the two is called a Night Dial. It was used prior to the seventeenth century for determining the time at night by observations of the stars either in Ursa Major or in Ursa Minor. There is no date or maker's name upon the instrument, but only the words "For both bears."

To make an observation, the observer stood looking towards the pole star, he then held the instrument as nearly vertical as possible, and turned the hand or arm until it was parallel to the position of the "pointers," or the stars in the "little bear," as the case might be. The time was then read off on the inner boxwood circle, which had to be set afresh for every day of the year. There was no plumb line attached to the instrument, and it must therefore have been very inaccurate.

The other instrument was called a Backstaff, because the observer in using it turned his back to the sun: looking at the opposite horizon; the observation giving the sun's zenith distance. It was the instrument which immediately preceded the sextant of Hadley. The Backstaff was invented in 1591 by Capt. Davis, who lived near Dartmouth and who sailed for the South Seas with Cavendish. Prior to this there was in use an instrument called a Forestaff. It consisted simply of a staff with cross pieces, which could be removed to or from the observer's eye, until they subtended the same angle as the sun's altitude. The way in which the Backstaff was used was thus: The upper vane or sliding piece was set by estimation, a few degrees less than the sun's zenith distance. The observer then directed his sight to the horizon through the lower, or sight vane and the slit in the horizon vane, moving the lower vane until the image of the sun, caused by the lens in the upper vane corresponded with the horizon line, the degrees and minutes read on the diagonal scale on the lower arc being added to the degrees on the upper arc, gave the true zenith distance. This instrument is in its original condition except the lower vane, which I added myself.

The President: Would that give a very approximate result?

Mr. Lecky: I tried it with the sun yesterday and found I could take a fairly accurate observation, with practice, within, perhaps, a quarter of a degree or so. (Laughter.)

The President stated that the Astronomer-Royal had sent to the Society several copies of his last Report on the Greenwich Observatory. They were laid on the table, and any Fellow was at liberty to take one.

Mr. Marth exhibited a sketch of Saturn and the orbits of his satellites as they would appear about the middle of August. The present year, he explained, was a very important one for observations, not only of Japetus, the outer satellite, but also of some of the inner

ones. Though Japetus was known for two centuries, the opportunities for observing it when the earth was not far from the plane of its orbit and the circumstances were therefore most favourable for determining the orbit, had always been neglected, except eighty-eight years ago by Bernard at Marseilles, whose observations, unfortunately, were now of no practical value. Herschel did not begin his observations till two years later, and he observed only one conjunction, on the 20th of September, 1789, when the satellite passed at a distance of about 7 semi-diameters of the ball. The ring appeared then as a very thin line, and as Japetus took about ten hours to travel through a space equal to the diameter of the ball of Saturn, it would be very difficult to judge at what precise time so long a perpendicular line from the satellite to the ring hit the centre. Herschel, no doubt, had been very careful in his estimations, and when he had come to a certain minute, he said "very nearly central" and 3 minutes later "perfectly central," but then, unluckily, his observations had come to a stop and we did not learn when the conjunction was past. Yet this single observation of Japetus was almost the only one of any value preceding Bessel's observations of 1831. The circumstances in the present year would be more favourable for observing the conjunctions. The plane of the orbit of Japetus would not pass through the sun till early next year, but the earth had already approached close to this plane, so that there had been an occultation of Japetus by the ring and ball of Saturn on May 24th, and there would be a transit across the disc on July 2nd. At the next conjunction, on August 11th, the orbit would have opened again so far that the satellite would pass outside the disc, and the conjunction would very likely be the most important one of this season, especially as it would probably occur at a convenient hour for observers in Europe, though this was not certain. The following inferior conjunction would take place on September 18th, but European observers would not have the opportunity of observing the conjunction with the centre, but only the conjunctions with the preceding and following edge of the ring; it was, however, to be hoped they would not neglect to observe angles of position. Further, on October 29th, there would be a favourable superior conjunction, and on October 30th, Japetus would be eclipsed, though the times of its disappearance and re-appearance could not be predicted. Finally, there would be an inferior conjunction on December 7th, and on December 8th the shadow of the satellite might, in America, perhaps be visible on the disc, provided the satellite be big enough to cast a shadow so far, about which we at present knew nothing.

With respect to the inner satellites, observations of their

conjunctions with the centre of Saturn in the present year would likewise be of great importance. Their orbits were now closing in or became narrower, but were still sufficiently open to show the satellites passing outside the disc; even in the case of Enceladus, though the sketch for the middle of August showed the orbit grazing the disc, the satellite would keep clear of the disc by the end of the month, and would remain so for the rest of the season. Now, he would beg the gentlemen, who had sufficiently powerful telescopes at their disposal, not to neglect their opportunities, but to watch and note the times when the satellites were in conjunction with the centre or passed in the direction of the minor axis of the ring. Ephemerides were now being printed in the *Astronomische Nachrichten* and the approximate times of the conjunctions would also be given in the *Astronomical Register*. It was essential, that observers should not only state the exact time when to the best of their judgment the real conjunctions took place, but also the preceding and following times, when they had begun to become doubtful and when they had ceased to be so, an interval which might extend over a good many minutes. If we should ever succeed in learning something of the mutual perturbations of these satellites, it would be, probably, chiefly by careful observations of such conjunctions. It was to be borne in mind that in the case of Jupiter's satellites the whole effect of their mutual perturbations amounted for the first satellite to less than 4 minutes in the times of conjunctions; for the second satellite to about 16 minutes, for the third to 4 minutes, and for the fourth to less, disregarding here the eccentricities and the shifting of the great axes.

The worst case was that of poor Hyperion. Though the satellite had been discovered more than twenty-five years ago, it was not feasible yet, for want of the needful observations, to make a trustworthy prediction of its positions. For more than ten years no observations had been made, until the lately published ones, made at Washington. Of the three observations of last year, however, the date of one was doubtful, and he was very much puzzled what to make of the two others. It might turn out, but at present it was merely a surmise, that the true time of revolution of Hyperion was much nearer to commensurability with that of Titan, in the proportion of three to four, than the older observations had indicated. The case of the perturbations of the motions of Hyperion by Titan was in its way unique in the solar system. Fortunately, he had received the promise from Washington, that the observers there would do their best to furnish good series of observations. The only one who might, possibly, have got some sort of satisfaction out of the neglect of

Hyperion, was Mr. Lassell, but it would have been a sorry kind of satisfaction, and he knew well enough that Mr. Lassell was only too willing to give up the position that, with the exception of the Cambridge observations of 1848, all the known observations of Hyperion had been furnished by him or by his instruments.

The President said the Society was indebted to Mr. Marth for calling the attention of astronomers to these satellites. It was hardly creditable to astronomers at this time of day that they should know so little about their orbits, and that no attention had been paid to their mutual perturbations. He hoped they would be able to remove that reproach before long, and that these conjunctions would be observed.

Mr. Marth said he had forgotten to mention, as an illustration of the necessity of watchfulness in not letting slip opportunities, that of the 22 conjunctions of Titan with the centre of Saturn, which would occur between the end of June and the beginning of December, probably not one would be observable in Europe, the reason being that one revolution of Titan was very nearly equal to 16 sidereal days, but that the Melbourne and Washington observers might have the opportunities of securing them all between them.

Capt. Noble: There was one expression used by Mr. Marth which suggests a question or two. It was that in which he recommended the possessors of large telescopes to observe Japetus and the other satellites of Saturn, for the purpose he has indicated. Now, there is, or was, a large telescope in this country which I imagine would be the very thing for the purpose, but we hear nothing whatever about it. We did once. It was a 25-in. refractor. There was a great deal said about it at one time, but it appears to be like the dramatic stars, of whom Dickens said that they come out and they go in again. This telescope appears to have come out and to have gone in again, and I should be glad to know if any gentleman can enlighten me about it. It was represented to have cost a large sum of money, but nothing that I can hear of has ever been done with it from that day to this. It would be the very instrument to devote to these observations.

Mr. Marth: Since the instrument is at present lost to science, it seems scarcely worth while saying anything about it.

The President: I think we are diverging from our subject. I don't quite see that what Capt. Noble says throws any light on the orbits of Saturn's satellites.

Capt. Noble: I thought that telescope was just the instrument to be devoted to this special purpose.

The President: I think we should now go on to some other business. I believe that Capt. Abney has a communication.

Capt. Abney: I venture to bring before you a small instrument which I have called a *Diaphannometer*. It can also be used as a photometer. The instrument consists of a wedge and a moveable slit with means for fixing a partially opaque body in juxtaposition with the wedge. I have used it for estimating the translucency of films of collodion negatives, and have made a great number of determinations with it. It only requires sufficient light, and the determination is as accurate as when using an ordinary photometer.

Mr. Knobel: In making observations with the astrometer, described at the December meeting, it occurred to me that by removing the silver surface from the mirror of my telescope, I should probably be able to reduce the light of naked-eye stars so much as to convert them into telescopic stars—understanding by a telescopic star one which requires an aperture larger than the pupil of the eye for its exhibition. The silvered plane was retained so that the only alteration made was in the silver surface of the mirror. The object in retaining the silvered plane was that one series of observations made with the silvered mirror might be easily compared with another made with the unsilvered mirror by merely knowing the ratio of light reflected at a perpendicular incidence from polished silver and the external surface of glass. Incidentally, also by these two series of observations to determine this ratio with some approach to accuracy, Sir John Herschel gives this ratio as 905 : 43; the only observations I have been able to make of the same star, with the silvered and unsilvered mirrors, give a ratio of 1000 : 125—but though this cannot be relied on, the error is not very great.

With the unsilvered mirror I can extinguish all stars from the 1st to the 9th or 10th magnitudes, and with the silvered mirror stars down to the 15th magnitude. By these means of observation I hope to connect naked-eye and telescopic stars in one unbroken chain. Mr. Dawes found 0·15-inch was the limiting aperture for an average 6th mag. star. This aperture I find to be the limiting aperture for the Pole-star. The observations are compared with the magnitudes of the stars given by Argelander in his *Durchmusterung*. The star magnitudes in this work seem to be more accurate than those in the *Uranometria Nova*. Anomalies and contradictions are almost inseparable from such observations, but I attribute them to physiological rather than to atmospheric causes. Comparison of Arcturus and Vega made on one night, Arcturus 1·0 mag. and Vega 1·8, and on another night Arcturus 1·0 mag. and Vega 1·7, but on the latter night the moon was only 30° south of Arcturus, and was affecting its

light much more than that of Vega. But the consideration of 1st mag. stars may be better left to the observations I hope to be able to undertake, reducing the light still more by employing a prism with reflection from external surface only, in the place of the diagonal plane, and so necessitating a larger limiting aperture. The observations consist of an investigation of the light of between 60 and 70 stars in the constellations Ursa Major, Ursa Minor, Draco, Boötes, and Corona Borealis. I think they will probably be sufficient to show what value may be attached to the method, and how far it may be rendered available for improving our knowledge of the magnitudes of stars.

The President: I would like to ask one question, whether you have reason to believe that Argelander and the different estimates of the magnitude in the *Uranometria* and the *Durchmusterung* correspond to any difference in the mode of estimating the star, or whether there is a constant difference, a difference all in the same direction for these different stars; whether they are all made of a larger magnitude in the one than the other, or whether there is a variability, whether some are made larger and some smaller in the *Durchmusterung* than in the *Uranometria Nova*.

Mr. Knobel: I think some are made larger and some smaller. I could show half a dozen stars showing a great difference.

Mr. Marth pointed out that in the *Uranometria Nova* 6·5 meant a star not fainter but brighter than one of the average 6th magnitude. In the case of the brighter stars, say down to 5·6m., the magnitudes of the *Uranometria* were on the whole more to be depended on than those of the *Durchmusterung*. But it would have been preferable to chose the 5th instead of the 6th as the standard magnitude, since the 6th class of the *Uranometria* contained some discrepancies, which Argelander himself had explained. With respect to the notation of the *Uranometria* Argelander had followed the custom of the elder Herschel, who, when he intended to express that a star was rather brighter or fainter than an average star of a certain class, added after a stop the figure of the brighter or fainter class, so that the added figures must not be taken as decimals, but 4·3 merely meant a bright 4th, and 4·5 a faint 4th. The reason for not employing decimals had obviously been some reluctance to noting down the fictitious tenth, when in reality there were only two sub-classes. In the *Durchmusterung*, however, the magnitudes were expressed in decimals.

The President said they were very much indebted to Mr. Marth for his explanation. He presumed that Argelander would not have written the 0 at all for the 6th magnitude, but in all such

cases he would have written simply the figure expressing the magnitude without any o.

Mr. Knobel said the figures had been got from the Greenwich catalogue.

Mr. Lynn said that in the second Greenwich seven-year catalogue the precaution had been adopted of putting a small hyphen between the figures of magnitudes, instead of a dot, which might have been mistaken for a decimal point. No o occurred in that column, in which, when there were two figures, they were consecutive numbers, the first printed expressing that which the star's magnitude was nearest. In the notes, however, where more exact magnitudes were referred to, a decimal dot was used.

Mr. Waters: Some little time ago Mr. Browning made an instrument for estimating star magnitudes for me. It consisted of a neutral tinted wedge, with an index in order to determine the point at which the star was extinguished by the gradual thickening of the wedge, as it was pushed forward over the eye-piece; and from the very imperfect means I have at my disposal, I believe that, if it could be applied with a thoroughly good telescope, it would give satisfactory results in determining the magnitude of stars. I think the third of a magnitude.

Mr. Marth said that differences of magnitudes might be determined by naked eye estimation to something like 2-10ths of a magnitude or less, provided the differences themselves did not much exceed half a magnitude.

Mr. Christie: The magnitudes of the stars I selected as standard stars were determined by Piazzi, Argelander, and Heis. I carefully confined myself to stars for which those three authorities agreed; but I found great differences of brightness, even in these sixth magnitude stars. For the stars of which I measured the brightness, I found the probable error of a single measure was not more than a 20th of a magnitude, and with a little practice and much care one would get to very much greater accuracy. I had very favourable means for comparison with a photometer, with which I compared for different colours. This is of great importance in the method of extinguishing apertures, for if you have a red star like Arcturus and you limit the aperture, you will require a much smaller aperture than you would with a blue or white star like Vega, because a red star stands out against the background of the sky, and you perceive the contrast of colour between it and the background. Thus we find that red stars can be observed in the daytime more readily than white stars of the same magnitude. This is a point that must be considered when you deal with magnitudes simply determined by extinguishing the star by limiting the aperture.

Mr. Brett said that he believed the great obstacle to the determination of the magnitude of stars is the existence of cirrus clouds, which are so faint that they are hardly discernable. The next hour you might observe them again and believe the star was a variable star. (Laughter.)

Mr. Lascell said that that could not occur, for if the observations were carried on for three or four following nights, and the results were very discordant, the observations would be rejected and a new series made.

Mr. De la Rue stated that the instruments which he presented some time ago to the University of Oxford were now placed in the new observatory there. The chief instruments were a 13-in. reflecting equatorial; a 13-in. zoneing altazimuth and two extra mirrors, a polishing machine, and a Foucault's apparatus for testing specula. The other day, while making an observation with one of these instruments, he inadvertently used his left eye, and was delighted to find that he had recovered perfect vision. (Applause.) The observatory was a splendid establishment with two domes and a corridor, and altogether it might be considered one of the best fitted, as it certainly was one of the handsomest, observatories in existence.

The President: I am sure the Society will congratulate Mr. De la Rue and the Oxford University on the possession of such a magnificient observatory, and I am sure that the result of the first observation made by Mr. De la Rue will be infinitely gratifying to all of us. (Applause.)

Mr. Dunkin read a paper by Mr. Proctor, *On Photography in the transit of Venus*. He said that Mr. Christie had misapprehended the object of his note. Mr. Rutherford, in papers relating to the transit, had said that the photographs of the sun will be greater according to the energy of the rays which have produced the image, and this may be produced by a change of the aperture, length of the exposure, translucency of the atmosphere, or sensibility of the chemicals. The papers from which he had quoted dealt fully with all the points raised by Mr. Christie, Mr. De la Rue, and Captain Abney. But at the present time it would be waste of time to discuss these points, because an examination of photographs conducted without favour must lead to a tolerably exact determination of the relative value of the various methods. Referring generally to the recent transit results, two things seem clearly established; first, contact-observations have been shown not to possess the accuracy required for improving our estimates of the sun's distance; secondly, observations taken with a low sun seem to have been unsatisfactory. He had found, from the projections of the next transit, that these two conditions will introduce serious

geographical difficulties, in fact, the efforts necessary to success would be greater than the mere observation of Venus in transit would justify. One physical observation of some importance remained to be mentioned. Referring to the arc of light seen round the limb of Venus outside the sun, it was remarked at the last meeting that the atmosphere around the planet could not account for the phenomenon, because it would disperse the light between the planet and the earth, so that it could not appear as the brilliant ring described and retain the power of photographing itself. This remark was based on an error. The pencil of rays proceeding from any part of the sun in such a way as to reach the terrestrial observer remains just as much a pencil of parallel rays after, as it was before its refraction took place; setting absorption aside, it would be equally bright with another pencil of equal size passing nearer to the planet's surface, which might pass between the earth and the planet. It is easily seen that if the principle were correct, we ought not to see the setting or rising sun; in fact, since the sun's rays diverge, we ought never to see the sun at all, a conclusion not reconcileable with our experience. As to the brighter spot near the pole of Venus, assuming that we know the axial position of Venus, it may be due to a clearer atmosphere over the planet's polar regions. It was quite to be expected that this ring of light would be bright. Maskelyne in his account of the transit of 1769, recorded enough to show that Venus has an atmosphere, and that the time of internal contact could not be satisfactorily determined.

Mr. Christie said Mr. Proctor seems to have been dicussing this question of photography from a theoretical point of view, without having considered the distinction between photographs obtained by different methods. It is a very common idea that whatever you see with the eye is developed in the photograph, but that does not at all hold, and this is really the essential point in this question. To the eye there is a great gradation on the sun in passing from the centre to the limb, and the photographs obtained by the process now in use at Greenwich give this gradation; but the photographs of the transit were developed so as to give a picture of the sun equally distinct and sharp at the limb and at the centre, therefore the effect of irradiation at the limb is the same as that at the centre; and it is for this reason that I stated it as my opinion, that the irradiation or encroachment of the sun on the sky at the limb would be found sensibly equal to that of the sun on the black planet Venus. Of course, if there is greater photographic density with the dry plate at the centre of the sun than there is at the limb, that could not hold; but in the results obtained, at any rate by the British Expeditions, I think I am

quite safe in stating that the graduation will not be appreciable. I have examined the photographs as carefully as I could. My friend, Captain Abney, has also made some important experiments on this question of irradiation; he arrives, by theory founded on his experiments, at the same result as I do, and, as far as I can see, it seems from his reasoning that we should get the same irradiation at the centre of the sun's disc as we do at the limb; but of course everything depends on the process that has been employed, but it is no use theorising as to what the photographs ought to show.

The President: I don't see that in that paper Mr. Proctor does anything to compare the different methods of photographing.

Mr. Christie: It is involved in the question, because he takes exception to my assumption that the irradiation of the sun outwards on the sky, which increases the diameter of the sun, would not be equal to the encroachment on the diameter of Venus; which involves the assumption that the irradiation for the centre of the sun would not be equal to that of the limb, but if it is not absolutely as I have stated, we have the means of determining any very slight difference that there may be, but the difference, whatever it may be, will be very slight now, and will not appreciably affect the result.

Mr. Neison: It seems to be generally supposed that we are without any information as to the probable density or horizontal refraction of the atmosphere of Venus. I think some observations have been made by Mädler which prove that the horizontal refraction amounts to 45·3 minutes, and that result has been closely confirmed by separate observations by Professor Lyman, of America, who obtained 43·7 in 1866, and 44·5 in 1874 (during the late transit). From that value the horizontal refraction compared with that due to our atmosphere, the density of the atmosphere of Venus appears to be just half as great again as the earth's, and applying the horizontal refraction to the refraction of the sun's rays the mean amount of solar rays from the centre of the sun would pass through the atmosphere of Venus at a height over six miles above the surface, so that the density of the atmosphere would be only one-quarter of what it is on the earth, and the amount of absorption that would occur would be much less than affects the sun's rays in passing through the earth's atmosphere, and of course the effect in treating of the diameter of Venus would be nothing, six, ten, or twenty miles would be an inappreciable quantity.

Mr. Russell: Mr. Proctor has taken exception to some of the remarks I made at the last meeting. I may say it is a great

pleasure to me to be here in a Society in London to discuss these subjects; but I should be sorry to enter into a discussion with Mr. Proctor, because I live too far off to carry it on. If we apply Mr. Proctor's reasoning to the case of the eclipse of the moon, we must come to the conclusion that the moon must be illuminated by white light. Now, I think that no one who has seen the moon eclipsed would say that it is illuminated by white light; my own experience has always been a red and faintly green light, and it is on that I based what I stated the other night—that light passing through an atmosphere must become refracted and dispersed into a spectrum; and, in that case, it would not have actinic power sufficient to impress itself upon the plate, and could not appear as brilliant as the sunlight. I think the case of the moon is a much more satisfactory thing than any theoretical argument. There is one other point I allude to. Mr. Marth has drawn attention to the satellites of Saturn. Everybody seems to think there is only one observatory in the southern hemisphere, and I was rather surprised to see Mr. Stone sit quietly and hear it; but we have a very good telescope at Sydney, and shall be glad to use our 11½-inch refractor for observing Saturn.

Mr. Stone: I sat quietly because we can have nothing to do with such affairs, as we have only a 7-inch. But there is one question I should like to ask, as I may not have another opportunity, whether any one knows anything with regard to the reductions of Brisbane's Catalogue. The observations were reduced by Mr. Richardson. I am at the present time working at star places, and it is a matter of considerable interest to know whether any one present could tell me where the manuscripts are likely to be. The Astronomer-Royal does not know.

Mr. Dunkin: I am sorry Mr. Stone did not ask this question a few minutes ago, because Mr. Glaisher was employed on the reductions, and he has only just left the room.

Mr. Stone: If I can learn in a week or a fortnight it will do.

Mr. Dunkin: It is a great pity, in all calculations of this kind, that the manuscripts are not placed in some public department. As Secretary of this Society, I shall be very glad indeed to take charge of any books or manuscripts of any importance. Now, for instance, if Sir Thomas Brisbane had placed his manuscripts in the custody of this Society, we should be able to give them to Mr. Stone at once; whereas now, very likely, they are destroyed or sold off for waste paper.

Captain Noble: One question I should like to ask Mr. Christie. He has told us of the mode adopted by the British expeditions, and that they have succeeded in producing perfectly flat pictures

of the sun. Is that done by development or in the exposure of the plate?

Mr. Christie: The way in which I understand it, speaking rather loosely, is that what you may call the photographic power of the collodion film is used up for the limb of the sun, so that there is no more left for the centre; the film being opaque, the light will not act at more than a certain depth, however you increase its actinic power. There is a curve which Capt. Abney has found to represent the rate of action of the light, and that curve has an asymptote—when that part of the curve is reached very little difference is made by differences in time of exposure, development, or photographic manipulation: that is the explanation as I understand it. I cannot profess to be an authority on the question, I am only speaking from the photographs I have seen and the impressions they have produced on me independent of all theory.

Mr. Ranyard: As regards the bright line round the dark body of Venus, it seems to me the atmosphere of Venus cannot break up the light in the manner suggested by Mr. Russell. The red light seen upon the eclipsed moon is evidently caused by absorption of the sun's rays in our atmosphere, and not by reason of our air acting as a prism, for we can see no trace of yellow and violet light upon the moon's disc. If we consider the question geometrically, it will be seen that Mr. Russell's view is quite untenable. The red and blue images of the different parts of the sun would overlap and produce white light, for the angular dispersion produced by our atmosphere could not be equal to the sun's diameter. We know that as the sun rises and sets the dispersion caused by our atmosphere is not detected with the naked eye, and as seen at the moon, the dispersion of our atmosphere would only be twice as great, and that only for the light grazing the earth's limb. As to what I said at the last meeting about the bright line upon the dark limb of Venus being caused by illuminated dust or clouds in the atmosphere of Venus, I must now withdraw that suggestion, for if it were so the bright line ought to be seen as long as the illuminated clouds within the atmosphere of Venus are visible from the earth, that is, till Venus is at least 3° or 4° from the sun's limb, but in fact it appears that the bright line vanishes when the dark limb of Venus is only a minute or so from the sun's limb, and this seems to prove that the refractive power of the atmosphere of Venus must be very small compared with that of our own atmosphere.

Mr. Neison: You say it disappeared at the distance of a minute from the sun's limb, but as a matter of fact it has been seen five hours before the contact by Prof. Lyman.

Mr. Ranyard: Indeed! Do you mean the bright line round the dark limb as well as the crescent?

Mr. Neison: Yes; five hours before. I think it was not looked for after the dark body of the planet was off the sun, until nearly two complete days after, when it was again seen. (Laughter.)

The President: Are you not proving too much now?

Mr. Neison: I think the paper to which I am referring stated that it was seen on the 10th and 11th of December.

Captain Abney: The fact as stated in the paper Mr. Neison alludes to is certainly as he says.

Mr. Christie: Prof. Lyman has calculated the atmospheric refraction, and gets most accordant results. They did not look to me suspiciously accordant. It strikes me as a very remarkable paper, though I have not verified, of course, his results.

Captain Noble: Three or four days after conjunction the crescent would look like a hair line if you saw Venus at all.

Mr. Christie: The crescent was seen; the point was that the crescent was more than the semi-circle, and from the excess he calculated the refraction.

Mr. Marth: Mädler's observations were first made in 1849. I remember that 20 years ago the late Mr. Drew made a communication to this Society, in which he attempted to deduce the amount of refraction due to the atmosphere of Venus, from measurements of the breadth of the crescent. I pointed out to him the great uncertainty of his proceeding, and how much simpler and safer was the method, which Mädler had adopted, to arrive at his result. As he was unacquainted with Mädler's paper, I sent him a translation, which he afterwards communicated to the Society, and the substance of which is, I think, printed in the *Monthly Notices* of 1855.

Col. Campbell: I had a most favourable opportunity for observing at Thebes, with a 7½-inch refractor. The day was exceedingly clear. The sun rose with Venus on its disc about two hours before contact. I did not see the line of light until it was near the limb, where egress was going to take place. The line totally disappeared as soon as the planet made egress. It seemed to follow round it until the planet had entirely made egress, and then no more light was seen round the planet at all. My impression was that when it was on the brightest part of the sun, before it came near the limb, it was impossible to see the fainter line distinctly, until it got to the limb where the light is distinctly less powerful than in the centre, and is consequently appreciable to the eye. The observation was no doubt a good one, because the atmosphere was calm and beautiful. The

observations of four or five of us corresponded, and the photographs were well defined also.

Mr. Stone: At the Cape we saw this ring of light.

The President: Off the body of the sun?

Mr. Stone: When it was on the body of the sun and throughout the transit, but I hope that we shall now have the measurements of these photographs.

Mr. De la Rue: I will say a few words about these photographs, as there is some misconception. First, whether we use the Daguerreotype or the collodion processes, precisely the same effects take place, and if we wish to get a true picture of the sun by one or the other methods, we shall get the gradation light which is upon the sun; and if we wish to get the limb very distinct we over-expose the central parts of the sun, and expose just enough to bring the limb out for the strongest definition, without caring at all what becomes of the sun spots on the central portions. The method adopted by the English astronomers was to bring out very definitely the limb of the sun, and I repeat that the best plan is to wait till the measurements have been completed.

The President: We have had considerable discussion on this interesting point, and we now proceed to ballot.

The following papers were laid before the Society and partly read:—

Rev. R. Main: *Occultations of Stars by the Moon and phenomena of Jupiter's satellites, observed at the Radcliffe Observatory.*

E. Dunkin: *Note on the discovery of three minor planets*, 144, 145, 146.

Colonel Tennant: *Note on the suspected variability of B. A. C. 740, 4166, and 4193.*

Dr. Wolfers: *Comparison of the right ascension and declination of standard stars observed at Oxford in 1872 with the tabular right ascension and declination in the Berliner Jahrbuch.*

M. Liais: *Sur les prochaines oppositions de Mars pour la détermination de la parallaxe solaire.*

E. Dunkin: *Additional Note on the Proper Motion of B.A.C. 793 (Piazzi II. 123.)*

The Meeting adjourned at half-past nine o'clock till Friday, the 12th November.

A DISCLAIMER.—The Rev. Canon Beechey, of Hilgay Rectory, Downham, desires us to announce that he is no connection or acquaintance of Mr. W. J. H. Beechey, who has been expelled from the Astronomical Society for non-payment of his subscription.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MARS.

Sir,—I am anxious to make the list of observations contained in my Memoir on the planet Mars, which you were good enough to review in your January number, as complete as possible. I shall therefore feel indebted to any of your readers who have in their possession any drawings or physical observations of the planet of whatever epoque, if they will lend them to me for the purpose of collating with the observations I have already collected.

Your obedient servant,
FR. TERBY.

Rue de Boyards, Louvain,
Belgium.

TRANSIT OF VENUS

Sir,—In your report of my remarks at the Meeting of the Royal Astronomical Society on 14th May last, two numbers are incorrectly given. First, on page 134, for ten Janssen plates read *sixteen Janssen plates*. And again on page 139, instead of a *non-achromatic* glass of 4 in. aperture read a *non-achromatic object glass of 2 in. averture.*

Your obedient servant,
H. C. RUSSELL.

[We are sorry that these mistakes occurred. We sent Mr. Russell a proof but did not receive it corrected.—EDITOR.]

CHAMBERS'S HANDBOOK OF ASTRONOMY.

Sir,—I would invite the special attention of your readers to the announcement that in a few months a new edition of this book will be issued, and that Mr. Chambers desires to obtain the co-operation of students of astronomy in securing the greatest attainable degree of accuracy in the work. Chambers's "Handbook of Astronomy" is a volume of great value. Formerly, indeed, having had occasion only to refer to one or two chapters, I failed to recognise the great usefulness of the work, but the more I have used it, the more I have recognised its importance, as well as the great labour its preparation must have cost. Yet its value would be enhanced if students of astronomy, who have sufficient leisure, would search through the present edition for such omissions and mistakes as cannot but exist in a work of this extent, no matter how carefully the author may have been on the watch to correct them. It would be better still, perhaps, if Mr. Chambers were to distribute

copies of the proof sheets among several students of astronomy interested in procuring the issue of a perfectly trustworthy volume of reference. If he is waiting for volunteers, I do not think he need wait long. For my own part, though I cannot offer so much in this way as others may, I should be very glad to look over half-a-dozen sheets from any part of the volume Mr. Chambers might think I could deal with usefully.

One point I may mention here. It would add to Mr. Chambers's labour (and probably become soon an "emfatic noosence") if those whom he invited to look over proof sheets were to suggest alterations not necessary to secure correctness. At any rate suggested alterations ought not to be pressed, or any correspondence carried on except, at Mr. Chambers's express wish, respecting them.

I have a selfish motive in writing. In fact, I have two. First, I shall not allow many days to pass after the new edition is published without obtaining a copy, and the fewer errors it contains the more useful it will be to me. Secondly, if the plan of distributing proof-sheets is adopted and succeeds, I shall hope one of these days to invite similar co-operation from astronomers in the case of a book of my own, which may also, I trust, though in another way, be of use. But apart from these comparatively selfish considerations, I am certain, from my own experience, that it is most desirable that books intended, amongst other purposes, as books of reference, should be revised by others than the author. I suppose indeed that no author has ever published a work in which errors were not detected when it was too late to correct them. (An errata-slip is useless unless printed *before* a book gets into the hands of the reviewers, by which time, perhaps, more than a thousand copies are already issued to the public.)

Yours faithfully,
RICHARD A. PROCTOR.

London: June 25, 1875.

CURIOUS SUNSET.

Sir,—We enjoy in the Fen Districts even more beautiful sunsets than at the Sea-side, for we have "no thin mists to intercept his rays." But I last night observed so very remarkable an appearance that I think it worthy of recording, if only to elicit an explanation. Just before sunset, whilst still in cloudless beauty with his lower limb flattened and of a deep red colour, I noticed a beautiful column of light reaching half way to the zenith. It appeared a *little* wider than his own disc and of the same rosy tint, only of course much fainter. It continued long after the sun was set, slowly sinking behind the horizon after him and not finally disappearing till after nine o'clock. Could it be an edgewise view of the Zodiacal light? It certainly was not *a ray* in the ordinary sense of the word. There was not a single cloud *near the disc*, and only one remarkable little one right across the column, which seemed perfectly parallel.

Yours very sincerely,
S. VINCENT BEECHEY.

Hilgay Rectory,
Downham, Norfolk:
June 9, 1875.

OCCULTATION OF VENUS,

On the Morning of May 3rd.

Mr. C. Ragoonatha Chary, F.R.A.S., First Assistant Madras Observatory, writes in the *Madras Times*, April 29th, about this phenomenon, and gives a table of it for various important places in India. At Madras the disappearance would be at 34.39 m. a.m. local mean time; and the re-appearance 44·36 m. The former is only two minutes after moon-rise; but at Calcutta it would be fifty-four minutes after. Mr. C. R. C. remarks, "The re-appearance will be visible to all places south of Delhi and Hydabad (Scinde). Weather permitting, this last phenomenon will be especially beautiful to the naked eye observers; as Venus, when re-appearing from behind the dark limb, will burst forth infull brilliancy, like a lustrous diamond above the two horns of the crescent moon,—a rare and interesting scene which, though less impressive than the phenomena of total solar eclipse, will yet not be easily forgotten by even the least appreciative and intelligent individual who enjoys the pleasure of witnessing it."

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JULY, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXV. British Association map, 60° to 65° N. latitude.

Mare Humboldtianum (B.) the north part, see note (*a*) in the May list, No. 149 p. 129. Thirty-five degrees from the moon's western limb Strabo (35) which extends over five degrees; adjoining it on the east is Thales (36), 15° further east Democritus (38), 15° still further east Christian Mayer (40), 5° Cicero (496), a large individualized formation east of Christian Mayer and west of, but adjoining the still larger formation W. C. Bond (465). This name Cicero has not hitherto been published. No. 495 Darwin also unpublished is A (B. and M.) on the S.E. of Archimedes (120). W. C. Bond extends eastwards as far as four degrees east longitude, part being in the western and part in the eastern hemisphere. The southern part only of W. C. Bond is in Zone xxv. From 7° to 14° east longitude Birmingham (463), 3° Fontenelle (171), 13° Herschel II. (412) the main portion of the floor; adjoining it on the east is Robinson (413) the north part, which adjoins the north part of Babbage (415). The southern portions of Robinson and Babbage with the whole of the crater "South" are in Zone xxiii. (*a*) 7° east of Babbage is Pythagorus (176).

(*a*) The craters and other formations now known as Herschel II., Robinson, South, and Babbage are described in a paper entitled "On a group of Lunar Craters imperfectly represented in lunar maps."—Report British Association, 1862, Transactions of Sections, pp. 9 to 12.

Cichus and its neighbourhood. In our May list we called attention to this part of the moon's surface. A partial description of it will be found in the *English Mechanic*, No. 533, June 11th, 1875. Mr. Neison has favoured us with a drawing of the region dated January 27th, 1874.

EPHEMERIS OF THE SATELLITES OF SATURN.

At 20h. Greenwich Sidereal Time.

The apparent distances of Titan and Japetus and the rectangular co-ordinates of the three inner satellites are expressed in semi-diameters of the planet's equator.—"Pos." = angle of position.

$+x$	**East of minor axis of ring.**	$+y$	**North of major axis of ring.**
$-x$	**West „ „ „**	$-y$	**South „ „ „**

1875.	Tethys.		Dione.		Rhea.		Titan.		Japetus.	
July	x	y	x	y	x	y	pos.	dist.	pos.	dist.
1	−2·7	+0·8	+2·6	+1·2	−1·0	−1·8	266·5	15·9	94·	5·2
2	+1·9	−0·9	+2·7	−1·2	−8·9	−0·1	272·5	19·5	134·	0·7
3	−1·0	+1·0	−6·2	+0·4	−2·2	+1·7	277·2	20·2	262·	4·2
4	+0·2	−1·0	+5·4	+0·7	+8·1	+0.8	282·5	17·7	265·6	8·9
5	+0·7	+1·0	−0·9	−1·3	+5·2	−1·5	291·0	12·4	266·6	13·5
6	−1·6	−1·0	−4·1	+1·0	−6·2	−1·3	317·2	6·0	267·3	18·0
7	+2·4	+0·9	+6·4	0·0	−7·4	+1·0	49·6	5·5	267·6	22·4
8	−3·1	−0·8	−4·3	−1·0	+3·5	+1·7	79·5	12·0	267.8	26·7
9	+3·8	+0·7	−0·7	+1·3	+8·7	−0·4	88·5	17·5	268·0	30·9
10	−4·3	−0·5	+5·3	−0·7	−0·3	−1·8	93·8	20·6	268·1	34·9
11	+4·7	+0·4	−6·2	−0·3	−8·8	−0·2	98·2	20·8	268·3	38·6
12	−4·9	−0·2	+2·9	+1·2	−2·9	+1·7	103·3	18·2	268·4	42·1
13	+5·0	0·0	+2·4	−1.2	+7·8	+0·9	111·3	13·2	268·4	45·4
14	−4·9	+0·2	−6·0	+0·4	+5·7	−1·4	132·6	7·0	268·5	48·5
15	+4·7	−0·4	+3·1	+1·1	−5·7	−1·4	214·4	4·8	268·6	51·2
16	−4·3	+0·5	−1·3	−1·3	−7·8	+0·9	255·2	10·5	268·7	53·6
17	+3·8	−0·7	−3·8	+1·1	+2·9	+1·7	266·5	16·2	268·8	55·7
18	−3·1	+0·8	+6·4	−0·1	+8·8	−0·3	272·6	19·6	268·8	57·5
19	+2·4	−0·9	−4·6	−0·9	+0·3	−1·8	277·5	20·1	268·9	58·9
20	−1.5	+1·0	−0·3	+1·3	−8·7	−0·4	283·0	17·5	269·0	60·0
21	+0·7	−1·0	+5·0	−0·8	−3·5	+1·7	292·1	12·2	269·1	60·7
22	+0·2	+1·0	−6·3	−0·2	+7·5	+1·0	320·8	5·8	269·1	61·0
23	−1·1	−1·0	+3·3	+1·1	+6·2	−1·3	51·4	5·9	269·2	61·0
24	+1·9	+1·0	+2·0	−1·3	−5·2	−1·5	79·6	12·3	269·3	60·6
25	−2·7	−0·9	−5·9	+0·5	−8·1	+0·8	88·6	17·7	269·4	59·8
26	+3·4	+0·8	+2·8	+1·2	+2·3	+1·8	94·0	20·7	269·5	58·7
27	−4·0	−0·6	−1·7	−1·3	+8·9	−0·1	98·6	20·7	269·6	57·1
28	+4·5	+0·5	−3·5	+1·1	+1·0	−1·9	103·9	18·0	269·7	55·2
29	−4·8	−0·3	+6·3	−0·2	−8·6	−0·5	112·6	12·9	269·8	53·0
30	+5·0	+0·1	−4·9	−0·9	−4·1	+1·7	136·0	6·8	270·0	50·4
31	−5·0	+0·1	+0·1	+1·4	+7·1	+1·2	217·8	5·8	270·1	47·5
August										
1	+4·8	−0·3	+4·8	−0·9	+6·6	−1·3	255·5	10·9	270·3	44·2
2	−4·5	+0·5	−6·6	−0·2	−4·7	−1·6	266·6	16·5	270·5	40·7

Approximate times of the conjunctions of the satellites with the centre of the planet.

Gr. Sid. Time.

		h.		y
July	1	15·7	Dione	+1·3
		18·0	Rhea	−1·8
		0·1	Tethys	+1·0
	2 ?	11	Japetus in conjunct. with the following edge of ring,	−0·2
		? 23	Japetus (v. page 122.)	−0·5
		22·8	Tethys	−1·0
		0·6	Dione	−1·3
	3	21·5	Tethys	+1·0
		0·3	Rhea	+1·8
	4	20·2	Tethys	−1·0
	5	18·5	Dione	−1·3
		18·9	Tethys	+1·0
		6·7	Rhea	−1·8
	6	17·7	Tethys	−1·0
		3·4	Dione	+1·3
	7	9·2	Titan	+4·0
		16·4	Tethys	+1·0
	8	12·3	Dione	−1·3
		13·0	Rhea	+1·8
		15·1	Tethys	−1·0
	9	13·8	Tethys	+1·0
		21·2	Dione	+1·3
	10	12·5	Tethys	−1·0
		19·3	Rhea	−1·8
		6·1	Dione	−1·3
	11	11·2	Tethys	+1·0
	12	9·9	Tethys	−1·0
		15·1	Dione	+1·3
		1·6	Rhea	+1·8
	13	8·6	Tethys	+1·0
		0·0	Dione	−1·3
		7·3	Tethys	−1·0
	14	6·0	Tethys	+1·0
		21·0	conj. of ♄ in A. R. with * W. B. 21·1153 * 25″4 north.	
	15	8·0	Rhea	+1·8
		8·9	Dione	+1·3
		13·2	Titan	−4·2
		4·7	Tethys	−1·0

Gr. Side Time.

		h.		y
July	16	17·8	Dione	−1·3
		3·4	Tethys	+1·0
	17	14·3	Rhea	+1·8
		2·2	Tethys	−1·0
		2·7	Dione	+1·3
	18	0·9	Tethys	+1·0
	19	11·6	Dione	−1·3
		20·6	Rhea	−1·8
		23·6	Tethys	−1·0
	20	20·6	Dione	+1·3
		22·3	Tethys	+1·0
		7·0	conj. of ♄ in A. R. with −* W. B. 21·1126 * 19″5 south.	
	21	21·0	Tethys	−1·0
		2·9	Rhea	+1·9
		5·5	Dione	−1·3
	22	19·7	Tethys	+1·0
	23	8·1	Titan	+4·1
		14·4	Dione	+1·3
		18·4	Tethys	−1·0
	24	9·2	Rhea	−1·9
		17·1	Tethys	+1·0
		23·3	Dione	−1·3
	25	15·8	Tethys	−1·0
		8·2	Dione	+1·3
	26	14·5	Tethys	+1·1
		15·6	Rhea	+1·9
	27	13·2	Tethys	−1·1
		17·1	Dione	−1·3
	28	11·9	Tethys	+1·1
		21·9	Rhea	−1·9
		2·1	Dione	+1·4
	29	10·6	Tethys	−1·1
	30	9·4	Tethys	+1·1
		11·0	Dione	−1·4
		4·2	Rhea	+1·9
		8·1	Tethys	−1·1
	31	11·9	Titan	−4·4
		19·9	Dione	+1·4
		6·8	Tethys	+1·1

A. M.

ASTRONOMICAL OCCURRENCES FOR JULY, 1875.

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
						Mars.
Thur	1	4	Conjunction of Moon and Venus, 5° 21′ S. Sidereal Time at Mean Noon, 6h. 36m. 31·74s.			10 59·2
Fri	2	17 24	● New Moon Sun's Meridian Passage 3m. 39·46s. after Mean Time			10 54·0
Sat	3	1	Conjunction of Moon and Mercury, 9° 17′ S.			10 48·8
Sun	4					10 43·7
Mon	5					10 38·7
Tues	6	11	Inferior conjunction of Mercury and Sun	1st Tr. I. 1st Sh. I.	9 40 10 57	10 33·6
						Moon.
Wed	7			1st Ec. R. 2nd Tr. E. 2nd Sh. I. 3rd Oc. D.	10 18 8 10 39 10 41 11 28	4 0·3
Thur	8					4 43·3
Fri	9	22 40	☽ Moon's First Quarter			5 24·4
Sat	10	10	Conjunction of Moon and Jupiter, 2° 21′ N.			6 5·1
Sun	11			3rd Sh. E.	8 44	6 46·3
Mon	12					7 29·3
Tues	13					8 14·8
Wed	14	11	Conjunction of Saturn and ι Aquarri (9·0m.) E.	1st Oc. D. 1st Tr. I.	8 46 10 39	9 3·2
Thur	15	7 8	Jupiter in quadrature with Sun Conjunction of Moon and Mars 0° 2′ S. Illuminated portion of disc of Venus=0·946 Illuminated portion of disc of Mars=0·966	1st Tr. E. 1st Sh. E.	8 17 9 33	9 54·3
Fri	16		Sidereal Time at Mean Noon 7h. 35m. 40·12s.	2nd Ec. D. 2nd Ec. R.	8 12 43 10 39 37	10 47·3

DATE.			Principal Occurrences.	Jupiter's Satellites.		Meridian Passage
		h. m.			h. m. s.	h. m.
Sat	17	9 6	Occultation reappearance of B.A.C. 6628 (6) Sun's Meridian Passage 5m. 49·35s. after Mean Time			Moon. — 11 40·7
Sun	18	1 26	○ Full Moon	3rd Sh. I.	10 35	Mars. — 9 37·3
Mon	19					9 32·9
Tues	20	6 7	Conjunction of Venus and Mercury, 3° 40′ S. Conjunction of Moon and Saturn, 2° 31′ N. Saturn's Ring: Major axis=41″·96 Minor axis=8″·69			9 28·7
Wed	21			1st Oc. D.	10 41	9 24·5
Thur	22			1st Sh. I. 1st Tr. E.	9 16 10 13	9 20·4
Fri	23			2nd Oc. D. 1st Ec. R.	8 13 8 36	9 16·3
Sat	24					9 12·3
Sun	25	8 39	☾ Moon's Last Quarter	3rd Tr. I.	9 18	9 8·4
Mon	26					9 4·3
Tues	27	19	Conjunction of Mercury and ζ^2 Geminorum (8·3m.) W.			Altair. — 11 23·8
Wed	28					11 19·8
Thur	29			1st Tr. I.	9 56	11 15·9
Fri	30	14 22	Conjunction of Moon and Mercury, 6° 14′ S. Conjunction of Moon and Venus 4° 35′ S.			11 12·0
Sat	31			1st Sh. E.	7 52	11 8·1
AUG. *Sun*	1			2nd Sh. E.	10 13	11 4·1

THE PLANETS FOR JULY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	7 14 9	N.18 30½	11″·7	0 37·5
	9th	6 51 30	N.18 2	11″·4	23 39·5
	17th	6 42 27	N.18 58½	9″·6	22 59·1
	25th	6 57 36	N.20 27½	7″·8	22 42·7
Venus ...	1st	5 7 31	N.22 7	10″·8	22 27·3
	9th	5 49 28	N.22 59	10″·5	22 37·7
	17th	6 31 52	N.23 8½	10″·4	22 48·5
	25th	7 14 16	N.22 35½	10″·2	22 59·3
Mars ...	1st	17 37 31	S. 27 50	25″·6	10 59·2
	9th	17 28 33	S. 27 56½	25″·1	10 18·8
	17th	17 22 50	S. 27 57	24″·1	9 41·7
	25th	17 21 0	S. 27 54	22″·9	9 8·4
Jupiter ...	1st	13 23 16	S. 7 23½	36″·1	6 45·6
	9th	13 24 41	S. 7 34	35″·2	6 15·6
	17th	13 26 45	S. 7 48½	34″·4	5 46·2
	25th	13 29 26	S. 8 6½	33″·7	5 17·4
Saturn ...	1st	21 53 4	S. 14 13½	16″·6	15 14·0
	9th	21 51 41	S. 14 22½	16″·6	14 41·2
	17th	21 50 0	S. 14 32½	16″·8	14 8·1
	25th	21 48 3	S. 14 43½	16″·8	13 34·7

Mercury may be seen in the morning before sunrise from the middle of the month, the interval increasing from half an hour to one hour and a half by the last day.

Venus is visible for an hour and a half before sunrise on the 1st of the month, the interval gradually decreasing.

Mars may be seen in the evening till an hour and three quarters past 1 a.m., at the beginning of the month, and till midnight on the last day.

Jupiter sets a little after midnight on the 1st, and on the last day soon after 10 p.m.

Saturn rises about 2 hours after sunset at the beginning of the month, the interval decreasing, rising on the last day about 40 minutes after sunset.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat. of the centre of the sun's disc.	Angle of position of sun's axis.	
1875.	°	°	°	°	
July 1	214·39	13·25	+3·08	357·40	+·45
2	227·64	·25	3·19	357·85	·46
3	240·89	·25	3·30	358·31	·46

	4	254·14	13·25	+3·40	358·77	+·46
	5	267·39	·25	3·51	359·23	·45
	6	280·64	·25	3·61	359·68	·46
	7	293·89	·25	3·72	0·14	·46
	8	307·14	·25	3·82	0·60	·45
	9	320·39	·25	3·92	1.05	·46
	10	333·64	·25	4·02	1·51	·45
	11	346·89	13·25	+4·12	1·96	+·45
	12	0·14	·25	4·22	2·41	·45
	13	13·39	·25	4·32	2·86	·45
	14	26·64	·25	4·41	3·31	·45
	15	39·89	·24	4·51	3·76	·45
	16	53·13	·25	4·60	4·21	·44
	17	66·38	·25	4·70	4·65	·44
	18	79·63	13·25	+4·79	5·09	+·44
	19	92·88	·24	4·88	5·53	·44
	20	106·12	·25	4·96	5·97	·43
	21	119·37	·24	5·05	6·40	·44
	22	132·61	·25	5·14	6·84	·43
	23	145·86	·24	5·22	7·27	·43
	24	159·10	·25	5·31	7·70	·42
	25	172·35	13·24	+5·39	8·12	+·42
	26	185·59	·24	5·47	8·54	·42
	27	198·83	·25	5·55	8·96	·42
	28	212·08	·24	5·62	9·38	·41
	29	225·32	·24	5·70	9·79	·41
	30	238·56	·24	5·77	10·20	·40
	31	251·80	13·24	5·85	10·60	·41
Aug.	1	265.04		+5·92	11·01	

A.M.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF MARS.

Greenwich Midnight. 1875.	Areographical longit. of the centre of ♂'s disk.		Areographical latit. of the centre of ♂'s disk.	Angle of position of ♂'s axis.	Diameter.
	°	°	°	°	″
July 1	126·2	+351·1	+1·31	30·95	21·48
2	117·3	1·1	1·48	31·10	21·45
3	108·4	1·1	1·64	31·24	21·41
4	99·5	351·1	+1·79	31·37	21·36
5	90·6	1·1	1·93	31·50	21·31
6	81·7	1·1	2·07	31·62	21·25
7	72·8	1·1	2·20	31·74	21·18
8	63·9	1·0	2·32	31·85	21·11
9	54·9	1·1	2·44	31·95	21·04
10	46·0	1·0	2·55	32·05	20·96
11	37·0	351·1	+2·65	32·14	20·87
12	28·1	1·0	2·75	32·23	20·77

13	19·1	1·0	2·84	32·31	20·68
14	10·1	1·0	2·92	32·39	20·58
15	1·1	1·0	2·99	32·46	20·47
16	352·1	1·0	3·06	32·52	20·36
17	343·1	0·9	3·12	32·57	20·25
18	334·0	351·0	+3·17	32·62	20·13
19	325·0	1·0	3·21	32·66	20·01
20	316·0	0·9	3·24	32·70	19·89
21	306·9	0·9	3·26	32·72	19·77
22	297·8	1·0	3·28	32·74	19·64
23	288·8	0·9	3·29	32·75	19·51
24	279·7	0·9	3·29	32·76	19·38
25	270·6	350·8	+3·29	32·76	19·24
26	261·4	0·9	3·27	32·75	19·11
27	252·3	0·8	3·25	32·74	18·97
28	243·1	0·9	3·22	32·72	18·84
29	234·0	0·8	3·18	32·69	18·70
30	224·8	0·8	3·13	32·66	18·56
31	215·6	350·8	3·08	32·62	18·42
Aug. 1	206·4		+3·03	32·58	18·28

A. MARTH.

Errata.—Page 143, line 13 from bottom, for *earth* read *north*; page 144 line 1, for *junction* read *function*.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sept., 1875.

Jackson-Gwilt, Mrs. H.

To Dec., 1875.

Corder, H.
Dearden, W.
Holland, P.
Murgatroyd, J.

To March, 1876.

Herschel, Professor A. S.
Pritchard, Rev. Professor.

To Sept., 1876.

Finch, A.

TO CORRESPONDENTS.

We are obliged to postpone interesting matter for want of space.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.
The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 152. AUGUST. 1875.

GREENWICH OBSERVATORY.

Good Mr. Editor,—Does no one think of the approaching bi-centenary of the foundation of the Royal Observatory? Must I myself call your attention to it?

Pray read in the History of my life, which has been published by my right good friend Mr. Baily, at page 39—

"The next thing to be thought of was a place to fix [the observatory] in. Several were proposed, as Hyde Park and Chelsea College. . . . . Sir Jonas [Moore] rather inclined to Hyde Park, but Sir Christopher Wren mentioning Greenwich Hill, it was resolved on. The king allowed 500*l.* in money, with bricks from Tilbury Fort, where there was a stock, and some wood, iron and lead from a gatehouse demolished in the Tower, and encouraged us further with a promise of affording what more should be requisite. In July following, I removed from his [Sir Jonas Moore's] house . . . . to Greenwich, to have an eye upon the workmen. The foundation was laid August 10, 1675, and the work carried on so well that the roof was laid and the building covered by Christmas."

In my time we reckoned in England according to the good old Julian style, but the proper day for celebrating the bi-centenary, according to your new-fangled popish method of reckoning (which, by-the-by, I don't think is an improvement) will I presume be the 20th of August, 1875, and accordingly I enjoin you to keep the day, not by feasting, but by making some useful astronomical observations, and in doing so feel thankful that you have better tools for your work than I had.

THE GHOST OF FLAMSTEED.

THE ROYAL OBSERVATORY.

Since we have been reminded of the coming bicentenary of the foundation of the Royal Observatory, we have referred to the following account of its origin, as given by Flamsteed, and quoted by Prof. Grant at p. 459 of his *History of Physical Astronomy* :—

"In 1675, a Frenchman, who styled himself Le Sieur de St. Pierre, represented to the English government that he was in possession of a method of finding the longitude *from easy celestial observations*, and claimed the reward offered for such a discovery. The method which he was desirous of communicating, was founded on a comparison of the observed and calculated distances of the moon from the fixed stars. A committee, consisting of Lord Brouncker, the Bishop of Salisbury, and several other individuals, was appointed to take the subject into consideration. Flamsteed, who, through the influence of his patron Sir Jonas Moore, was nominated one of the members of the committee, was requested to provide the observations which the Frenchman demanded for the purpose of illustrating the practicability of his method. Flamsteed speedily supplied the necessary observations, but he took occasion to remark that, however accurate they might be, the method was still defective, inasmuch as the best astronomical tables sometimes erred to the extent of 12′ in the moon's place. Moreover, he stated that the method tacitly implied that the places of the fixed stars in Tycho Brahé's catalogue were absolutely correct, whereas he had found by his own observations that they were generally 5′ or 6′ in error, and in some instances even more. The commissioners agreed unanimously in the justness of Flamsteed's remarks, and, at the suggestion of Sir Jonas Moore, it was resolved to memorialise the king, on the expediency of erecting an observatory for the purpose of making observations of the celestial bodies, which might serve for the discovery of the longitude, since the solution of that important problem appeared evidently unattainable by any other means.

The king gave his cordial assent to the views of the commissioners, and steps were immediately taken to carry them into effect. Flamsteed was appointed Astronomer-Royal, with a salary of 100*l.* a year. The warrant of Charles II. for the payment of his salary is dated March 4, 1674-5. He is therein styled "our Astronomical Observator," and it is declared that the duty of the office is "forthwith to apply himself with the most exact care and diligence to the rectifying the tables of the motions of the heavens, and the places of the fixed stars, so as to find out the so much desired longitude of places, for the perfecting

the art of navigation." The warrant for the building of the observatory is dated June 2, 1675. It modestly announces the royal resolution to build a small observatory in the park at Greenwich "in order to the finding out of the longitude for perfecting navigation and astronomy." Sir Christopher Wren is charged to prepare the plan of the building, and to select a proper site for it, and the Master General of the Ordnance is instructed to advance the funds necessary for its completion, upon the condition that the expense of erection do not exceed five hundred pounds.

The foundation stone of the observatory was laid on the 10th of August, 1675, and the building was finished in less than a year. Flamsteed took up his residence at it on the 10th of July, 1676, and shortly afterwards commenced his duties as an observer.

FLAMSTEED.

The following account of Flamsteed is taken from De Morgan's article in the *Penny Cyclopædia*; we would also refer our readers to the account of the early labours of Flamsteed in connection with the Royal Observatory which is given in Grant's *Physical Astronomy*, pages 467 to 478, and to Baily's *Account of the Rev. John Flamsteed.*

The life of the first Astronomer-Royal was known to the world chiefly by the results of his labours until the year 1832; since which time his private affairs have been brought to light in an unexpected manner, and have excited great interest, not without creating some party feeling among those who cultivate the sciences connected with astronomy. In 1832 Mr. Francis Baily discovered that a considerable collection of Flamsteed's letters was in the hands of a private individual: which on being examined was found to contain much that was not generally known. On searching the observatory at Greenwich Mr. Baily found a vast mass of MS. observations, letters and other documents, in the handwriting of Flamsteed and his friends, containing the curious history of which we shall give a brief abstract. The result of this discovery was a representation to the Board of Visitors of the Royal Observatory, who recommended the re-publication of the *British Catalogue* with extracts from the papers of Flamsteed. The Lords of the Admiralty having decided to print this at the public expense, Mr. Baily undertook the preparation of the work, which appeared in 1835, under the the title of *An Account of the Rev. John Flamsteed, &c., &c., to which is added his British Catalogue of Stars, corrected and enlarged.* From this work, which is certainly the most remarkable scientific biography of the present century, we have chiefly drawn the materials of this

article. The original account is in part drawn by Mr. Baily from a manuscript by Flamsteed, headed "Self-Inspections, by J. F.," which is a very interesting autobiography.

John Flamsteed was born at Denby, near Derby, August 19th, 1646. His father was in some business, it has been said that of a maltster: he lost his mother when very young. At the age of fourteen he caught cold while bathing, which produced a weakness in the joints, from which he never recovered. He began his mathematical and astronomical studies at a very early age, and showed talents for constructing astronomical instruments.

In 1665 he visited Ireland for the purpose of consulting a Mr. Greatraks, who professed to cure disorders by the touch, and of whose experiments in London a curious account exists. No effect being produced on him by this treatment, he returned to Derby, where his father lived, and where he had received his education. Here he continued his studies till 1669, and with great success. In or before 1667 he discovered the real causes of the equation of time, and wrote a tract on the subject, which was afterwards appended by Dr. Wallis to his edition of the works of Horrox, published in 1673. In 1669 he made an astronomical communication to the Royal Society, through Oldenburg their secretary, concealing his name under the anagram —

J. Mathesin a Sole fundes,

which being transposed gives

Johannes Flamsteedius:

this same anagram appears in the title-page of the tables appended to the doctrine of the sphere in Sir Jonas Moore's system of mathematics, in the preparation of which Flamsteed had a share. An answer from Oldenburg, addressed to himself, showed him that he was discovered, and from that time, or rather from the date of a visit which he very shortly afterwards paid to London, he was in correspondence with many scientific men, but particularly with Sir Jonas Moore, who in 1674 proposed to establish Flamsteed in a private observatory, which he intended to build at Chelsea. In the mean time, however, the fact of the very large errors to which astronomical tables were subject came to the notice of Charles II. on the occasion of a proposal made by a French gentleman for finding the longitude, and that king determined to establish an observatory.

Flamsteed was appointed Astronomer-Royal, or as the warrant ran "Astronomical Observator," and carried on his observations at the Queen's house in Greenwich Park, until the observatory was ready, which was in July, 1676. From this time Mr. Baily dates the commencement of modern astronomy: nor can such

chronology be disputed if we consider that we now return to Flamsteed's observations as the earliest with which it is desirable to compare those of our day, and also that Flamsteed's catalogue is the first which attained a precision comparable to that of latter times. Flamsteed was in fact Tycho Brahé—was a telescope. There was the same capability of adapting instrumental means, the same sense of the inadequacy of existing tables, the same long continued perseverance in actual observation. But Tycho Brahé, a rich noble, found his exchequer in a King's purse, while Flamsteed, a poor clergyman, defrayed the expenses of his instruments himself upon an ill-paid salary of £100 a year. Up to the year 1684 he had imposed on him the task of instructing two boys from Christ's Hospital as one of the duties of his post, and besides this, he was obliged to have recourse to private teaching to meet the charges of carrying on his observations. At the very same time that part of the public which cared about the matter were beginning to require that he should print his observations.

Almost at the outset of his labours he was so well known that Dr. Bernard invited him to become a candidate for the Savilian Professorship of Geometry at Oxford, which he declined to do. He had at this time nothing but a sextant and clocks of Sir Jonas Moore's and some instruments of his own. He borrowed some from the Royal Society, and after repeatedly urging the Government to provide him with an instrument fixed in the meridian, he caused a mural arc to be constructed at his own expense, which was erected in the year 1683, but proved a failure.

In the meantime he had taken orders in 1675, having in the previous year obtained the degree of Master of Arts from Cambridge. It is not certainly known that he had been a student in that University, though it is certain that he was for some months at Cambridge in 1674. Perhaps he obtained his degree by the celebrity of his name, on condition of a short residence.

In 1684 his father died, and he was presented to a small living by the Lord-Keeper North. Both circumstances increasing his means, he resolved to be at the expense of a new mural arc, upon an assurance from the Government (which was never fulfilled) that the outlay should be repaid. This instrument was first used in September, 1689, and from that moment everything which Flamsteed did, every observation which he made, assumed a tangible and permanent form, and was available to some useful purpose; when he died, the Government of the day attempted to claim these instruments as public property.

The public career of Flamsteed from this time to the end of his life is described when we say that he collected that enormous

mass of observations which furnished the first trustworthy catalogue of the fixed stars, that he made those lunar observations on which Newton depended for the illustration and verification of his lunar theory; and that he originated and practised methods of observing which may be said to form the basis of those employed at the present time. Were it not for the celebrated quarrel between him on the one side, and Newton and Halley on the other, there would hardly be a life of so much utility as that of Flamsteed which would afford so little materials for a popular account. It is to be remembered that the following is an *ex parte* statement, but on the other hand it is not one formally drawn up for the public, but partly contained in the manuscript autobiography which never was published by Flamsteed, and partly derived from his correspondence with his friends. Many confirmatory circumstances of the general tenor of the facts appear in the letters of Newton himself: and even those who have (since the publication of Mr. Baily's work) defended the character of Newton, have not attempted to invalidate the account, but have mostly confined themselves to an attempt to show that Flamsteed did not appreciate the pursuits of Newton. The following is a sketch of the transaction :—Newton had been on terms of cordial intimacy with Flamsteed, but a coolness, the cause of which is not discoverable, had begun to exist in the year 1696. In a letter to Dr. Wallis, intended for publication, Flamsteed mentioned his having supplied Newton with observations of the moon: this the latter took very ill, saying, in a letter to Flamsteed, "I do not love to be printed on every occasion, much less to be dunned and teased by foreigners about mathematical things, or to be thought by our own people to be *trifling* away my time about them when I should be about the King's business." Before this time he had furnished Newton with all the lunar observations which he had made.

When Flamsteed had completed his catalogue (having already expended 2,000*l.* more than his salary) he began to think of printing his results. But Prince George of Denmark having heard of the extent of Flamsteed's labours, offered, in 1704, to bear the expense of printing. A committee consisting of Newton, Sir Christopher Wren, Dr. Arbuthnot, Dr. Gregory, and Mr. Roberts, was appointed to examine Flamsteed's papers, and reported in favour of printing all of them. The superintendence of the printing, the choice of workmen, &c., was in the hands of the committee, and not in those of Flamsteed. The latter gives the detail of various vexations to which he was subjected, and which ended (for the time) in a demand that Flamsteed should give up a manuscript copy of the catalogue of stars, which

was the result of the observations, and was intended to be published at the end. This was done with remonstrance by Flamsteed, but the catalogue (as much of it as was ready) was sealed up, and Flamsteed declares that he understood it was to be sealed up until the whole of the rest was finished. It was three years before the first volume was printed, and during this time many small circumstances occurred which, if Flamsteed's colouring of the more important facts be correct, show a most determined intention on the part of the committee to give annoyance. Prince George died in 1708, before the second volume was begun, and the office of the committee was gone, but they still retained the papers in their keeping. Flamsteed thinking nothing further about immediate publication, applied himself again to his observations. In March, 1710-11 he was surprised by being told that the seal of his catalogue had been broken, and that it was going through the press. Flamsteed immediately obtained an interview with Dr. Arbuthnot, who assured him that none of it was printed. This was not the fact, for in a few days Flamsteed himself received several printed sheets, and learned that Halley had publicly exhibited others in a coffee-house, and boasted of the pains he had taken in correcting their errors. The result was that in 1712 appeared the book known by the name of Halley, and entitled "Historiæ Cœlestis libri duo," &c. Flamsteed, exceedingly irritated by the conduct of Newton and Halley, and being not naturally of a gentle temper, now kept no terms whatsoever with either. Newton had recommended the appointment of a Board of Visitors for the observatory (made up of members of the Royal Society), and Flamsteed was summoned to the Royal Society, October 26, 1711, to know if his instruments (his own property) were in order, &c. Here a warm quarrel arose, Flamsteed declared to Newton that he had been robbed of his labours, and Newton called Flamsteed various names, of which *puppy* was the least. Newton reminded Flamsteed that he had received 100*l.* a year for 36 years, and Flamsteed asked Newton what he had done for 500*l.* a year which he had received since he came to London. Flamsteed charged Newton with having broken the seal of his catalogue, and Newton replied that he had the Queen's order. After this interview, Flamsteed resolved to print all his observations, &c., at his own expense, and applied to Newton for the manuscript of 175 sheets of observations, which were in his hands. The demand was refused, and Flamsteed commenced legal proceedings for their recovery. The result of the suit is not known, but Flamsteed states that Newton at last delivered all the contested manuscript to Halley. The additional expense caused to Flamsteed by this act was about 200*l.*

Queen Anne died in 1714, and the Earl of Halifax, Newton's great supporter at court, in 1715. Flamsteed was now stronger with the Government than his opponents: and the Lords of the Treasury, at his request, surrendered all that remained of Halley's edition (about 300 copies out of 400) to his mercy. These he immediately committed (in part) to the flames—a sacrifice, as he calls it, to heavenly truth—reserving only about ninety-seven sheets of each, which had been printed as he wished and which afterwards formed part of his first volume. From this time to his death, which took place at the end of December, 1719, he was occupied in printing his *Historia Cœlestis,* which, however, he did not live to finish. It was completed by his widow with the aid of Mr. Crosthwait, his assistant, and his friend the celebrated Abraham Sharpe, and was published in 1725. The maps, known by the name of *Flamsteed's Atlas*, were superintended by the same persons. The *Historia Cœlestis Britannica* contains a complete account of the instruments and methods employed, together with a large mass of sidereal lunar and planetary observations, and the result of the former, namely, the British Catalogue. This work seems to us to occupy the same place in practical astronomy which the *Principia* of Newton holds in the theoretical part.

REPORT OF THE RADCLIFFE OBSERVER TO THE BOARD OF TRUSTEES.

Read at their Meeting held on June 29th, 1875.
[Printed by order of the Trustees, for Private Circulation.]

The scientific staff of the Radcliffe Observatory is still composed of Messrs. Lucas and Keating, First and Second Assistants, and Mr. Bellamy, Junior Assistant; Mr. Luff is also employed as Computer. These gentlemen are credited with the same steady zeal, industry, and ability as in former years; and we cannot question that they have well earned such praise. A line or two of memorial is also devoted to William Quarterman, who, after filling the post of gardener for nearly forty years, and valued for his integrity and general usefulness, died in February last.

As to instruments; the Carrington Transit Circle is used by Mr. Lucas or Mr. Keating; the Heliometer by Mr. Bellamy, for double-star measurements, and the discs of planets. There is also the 10ft. telescope, with 7-inch object-glass used for occultations and other phenomena.

Notwithstanding many interruptions, owing to bad weather, the number of transits observed from June 24th, 1874 to June 24th, 1875 is 2,538; and the number of zenith distances 3,518. The number of stars observed in the same interval is about 1,300; and meridional observations have also been made of sun, moon, and planets. The sun-spots have been often observed; their position accurately ascertained, and their form, magnitude, and peculiarities carefully delineated. Occultations of stars,

and phenomena of Jupiter's satellites have been observed, and the observations have been communicated to the Royal Astronomical Society. Photographic meteorology has been carried on as usual under the management of Mr. Lucas.

In the reduction and printing of the observations a great advance has been made. The volume for 1872 was completed and circulated last February. The volume for 1873 is partly in print, and "very shortly some copies of the Catalogue of Stars (about 1,300 in number) will be ready for any astronomer who may have any special need of it." The reductions for 1874 are in a state of great forwardness. For 1875, the transits are nearly reduced to the end of May, but nothing has been done to the zenith distances.

A new observing Catalogue of Stars down to the 7-8th magnitude, in a zone extending from N. P. D. 53° to N. P. D. 63°, is in preparation. "In connection with preceding zones already partially observed, the whole will form a zone 20° in breadth, in a very important part of the heavens."

Additions to the Library are mentioned; and amongst presents received, "the large folio book of drawings of portions of the lunar surface, made by the late Mr. J. Russell, R.A., for his large picture of the moon which was presented to the observatory many years ago, and has always been suspended in the large octagon lecture-room. The presentation of these inestimable drawings has been made by the present representatives of Mr. Russell's family. The care of the library, in addition to his other responsibilities, devolves upon Mr. Lucas, whose time is also much occupied in the copying of letters, accounts, &c.: an important department, though devoid of the pleasure and *éclat* of celestial observations and computations, and not less really of service to science because homely and irksome; and thus, no doubt, it is regarded.

Mr. Main observes, "I had occasion to mention in two preceding reports that some of my time had been occupied with business relating to the New University Observatory recently erected in the Parks. [See *Astronomical Register*, 1874, pp. 4—9, 43, 44.] My responsibilities with regard to this are now very nearly at an end, the building of the observatory having been completed for some time, and the instruments being now mounted and ready for use;" and he thus sums up: "I think that I have, in the course of this report, given with sufficient detail every information concerning the condition and the action of the Radcliffe Observatory which can be required to enable the Board to form a judgment of its present condition and efficiency. I am equally well satisfied, as in former years, with the quantity of work which has been performed, and with the general accuracy of the observations; and, though I have frequently given careful attention to the subject, I do not see at present how, with the instruments at my disposal, I could advantageously make any organic change in the system of observations which is being pursued. It is one of the few observatories which prosecutes accurate star-observing (I mean as distinct from sweeping in zones) to such an extent as to make the observations of importance, and which also gives the yearly Catalogues to the public within a reasonable time after the completion of each year. Having then no large telescope at my disposal comparable with those with which most observatories are furnished, my aim has been to use with the utmost efficiency those which we have, namely, the transit-circle and the heliometer, the latter of which produces its results with much greater expenditure of labour than would be imagined by a person who has not used the instrument.

"It must also be borne in mind that our meteorological reductions are

reduced much more elaborately than is common at the greater number of observatories, and presented to the public in the most scientific form which they admit of. I am also of opinion that they are worth all the labour which is bestowed on them, and I differ somewhat in opinion from some eminent authorities as to the rank which meteorology already occupies amongst the physical sciences. At all events, I think that some such system of reduction should be employed at observatories where all the meteorological elements are regularly observed, and one of the greatest wants which I have experienced arises from the impossibility of comparing my own results with similar ones arrived at in other places.

"On the whole it may, I think, be considered that as much work of a good and useful character is performed as the resources of the establishment will allow; and that no organic change could be introduced with advantage in the system of observations pursued with the instruments at its disposal."

With this conclusion we think the readers of the report will cordially concur, and will be inclined to award more praise to the distinguished director, and his able assistants than is thus modestly claimed. It has been said of this observatory that it is second to none, after Greenwich, for the accuracy and value of its observations; and its reputation is not likely to suffer, whilst—leaving to the new Institution, which the munificence of the University of Oxford and Dr. De la Rues' generous gift have created, the cultivation of new branches of research—it is content to work on the old lines with the patient skill and conscientious toil which have distinguished it during so many years.

ON THE SCALES TO BE USED IN INTERNATIONAL METEOROLOGY.

The following letter has been addressed by Professor P. Smyth to Dr. Buys Ballot, President of the Permanent Committee of the Meteorological Congress at Vienna:—

Sir,—With reference to your printed official letter of 5th of May, 1875, and your kindly concluding assurance therein, that—

"The Committee will be especially pleased to learn my opinions on any point of International Meteorology, and to be informed of any point which may appear to me to be advisable to be taken into consideration, or to be treated in a different manner from that which has hitherto been the case."

I have the honour of placing before you, in reply, the following views on certain leading points, which I have been privileged to acquire during the last eleven years, touching the prosecution of the meteorology of the earth as a whole, viz.:

1st. The only absolutely unique, straight, true, and characteristic reference for length measure in, and for, the entire earth, and all the nations living upon it, is *the axis of rotation thereof.* And the most handy subdivision of it into small units for the every-day purposes of man in general, and his scientific barometrical observations in particular, which you are so deeply interested in, is the division into 500 millions (or *inches*, with further decimal subdivision of them when required); as securely monumentalised more than 4,000 years ago in the Great Pyramid, a building pre-eminently of number, weight, and measure, still standing in measurable condition in the centre of all the inhabited land surface of the whole globe.

2nd. If the greatest convenience of the greatest number of mankind, and the fact of man living on the surface of the earth, and not on any other planet of the solar system, are held to be of any importance in your International Meteorological Congress of to-day,—the *temperature* reduction of barometrical observations should be made to refer to the mean of all man's experiences of that kind on the earth; and not to any ideal extreme point of heat (or cold) outside them all, and in which he does not, and could not, live and flourish.

3rd. The true mean reference indicated above, or the mean of all man's temperature experiences in all the permanently inhabited countries on the face of the earth, is exhibited in a circumscribed manner in the mean temperature of that central building of all the terrestrial world, the Great Pyramid; and is further defined there as a temperature of ¼ *the distance from freezing to boiling* of water (at the mean level of sea *and* land, and with the barometer at its mean Pyramid height), and on a thermal scale where freezing reads 0, and boiling + 250.

4th. The weight reference for all nations, if they live upon the earth and have intellectual and scientific aspirations, should be founded on, and be evenly commensurable with, the size and weight of this planet, the earth, as a whole: a thing monumentalized also at the Great Pyramid ages ago, and with the practical result of showing prophetically, or for and at such subsequent time as man should be able to appreciate it, but not before, a grandly standard pound weight (to be further decimally subdivided as necessary) equal to the weight of 5 *cubic pyramid inches of the earth's mean density;* to be taken in air of the standard Pyramid temperature and pressure, or that most suitable and agreeable to man in all his employments; and by no means, as with some modern doctrinaires, in a freezing vacuum.

5th. Whereas modern science has absolutely no means of stating, or even approaching the question, whether the race of man is going to last on this globe for a few years more only, or, for almost unlimited millions of millions, and millions again of years; and such knowledge would be most important when deciding on the standards for future international Meteorology—it may be well to bear in mind, that the Great Pyramid, which has already seen all the history of intellectual man as yet,—and grandly anticipated, amongst other points of terrestrial and celestial physics, the very sun-distance determination of most nations in the present year,—contains a by no means uncertain limitation of his future.

For further particulars on all these several essential topics I beg to refer you to a little book just translated, and now being published in France, by M. L'Abbé and Chanoine F. Moigno. It is entitled, I believe,

LA GRANDE PYRAMIDE

PHARAONIQUE DE NOM

HUMANITAIRE DE FAIT

SES MYSTERES ET SES ENSEIGNEMENTS.

With expressions of the highest consideration, I have the honour to remain, sir, your most obedient humble servant,

PIAZZI SMYTH,
Astronomer-Royal for Scotland, and
Ex-Member of the Royal Society of London.

15, Royal Terrace, Edinburgh:
May 20, 1875.

ON THE NEBULA IN THE PLEIADES.

Letter of M. W. Tempel, Astronomer-Royal in Florence, to the Editor of the *Astronomische Nachrichten.*

[Translated from *A. N.*, No. 2,045.]

I am indebted to you and Mr. Pape for the first confirmation of the announcement made by me in 1860 of a Nebula in the vicinity of Merope. At the observatory in Milan I learnt from the *A. N.* that this nebula had been subsequently observed and described by various astronomers, though with the statement that it is better seen in small telescopes than those of larger size.

While at Marseilles I had only my 4-inch refractor at my disposal, and in Milan the large refractor was not put up till after I had left. At the latter place, therefore, I could only avail myself of the small equatorial by Plössl, which has the same aperture as my refractor by Steinheil, and the difference of the visibility of nebulæ and of faint comets exhibited by these instruments was at times incomprehensible. In the Plössl, stars and planets gave beautifully distinct images, while there was no trace of nebulæ or comets which were seen so well with the Steinheil. With the Plössl I frequently looked at the Merope nebula and found it barely distinguishable from the ground of the heavens. On the other hand it exhibited to me in the space occupied by this nebula the glimmering of numerous stellar specks which I did not see with the Steinheil.

When, on my arrival at Arcetri, I directed the two large instruments, one of eleven and the other of eight inches aperture, upon the Merope nebula I was greatly surprised to find it so *plain*, *large*, and (in one direction at least) so *sharply defined.*

With the Amici I. the same thing obtained as with the Plössl; there were seen in the space occupied by this nebula very many stellar specks. while with the Amici II. the nebula was seen much plainer, but the glimmering of minute stars was not shown. Professor Schiaparelli, to whom I am under so many obligations, upon the erection of his large refractor at Milan, took the friendly interest of turning it on the Merope nebula as the first test of its quality, and I make bold to cite below the very words in which he records the observation.

"On the 25th of last month (February), while we had deep snow, there were two hours during which the sky was tolerably clear, and I wished to avail myself of them to examine the Pleiades-nebula again. This time I saw it very well, and better than before. Merope is situated within the nebula, which appeared very brilliant round that star. I have found, especially towards the right hand (from the Merope upwards in your sketch), that the drawing agrees fairly well with the nebula. From Merope, however, towards the left the nebula seems to me to extend much further. Not only does it reach almost up to Electra, but it encompasses that star and Celœno as well. Beyond Celœno I saw nothing more * * * *It is singular that so many persons should have examined the Pleiades without paying attention to this great nebula, which nevertheless is so evident an object with a clear sky.*"

When, therefore, I read as follows in Vol. LIX. of the *A. N.*, No. 1,393, p. 13, "but of an object, the position and outline of which might be indicated by some means or another, I have hitherto been able positively to see nothing * * * I, therefore, even yet, am of opinion that this nebula is variable, otherwise the original announcement of the

discovery (*A. N.*, No. 1,290) must be looked upon as being greatly exaggerated." The satisfaction is afforded to me, after ten years' patience, not only of replying by the above to the somewhat disparaging judgment passed upon my original notice, but also of directing attention anew either to the main interest of the actual variability of a nebula of such considerable dimensions as this one, or to our unsatisfactory and uncertain knowledge with regard to the different powers of telescopes.

Royal Florentine Observatory, WILHELM TEMPEL.
at Arcetri: May 2, 1875.

ORIGINAL NOTICE OF THE DISCOVERY BY M. W. TEMPEL OF THE MEROPE NEBULA.

[Translated from *A. N.*, No. 1,290.]
Extract from a letter from M. W. Tempel to Dr. C. A. F. Peters, dated Marseilles, 23rd December, 1860.

Perhaps it will be of interest to you to learn that last year, while in Venice, not having looked at the Pleiades for six months, I, on the 19th of October, above Merope, (A. R. 3h. 57m. 40s., Decl. + 23° 23′) found a large bright nebula, which at the first moment I took to be a fine large comet, but convinced myself on the following night, the 20th, that its position remained unchanged. I have observed it here repeatedly, and many persons, M. Valz among them, have seen it in my telescope. Some time ago I distinctly saw a few minute stars at intervals in this nebula. On one side it is somewhat brighter.*

W. TEMPEL.

INDIAN NOTES.

We understand that Government will, in all probability, sanction the transfer to Simla of the magnificent set of astronomical instruments now in charge of Colonel Tennant, at Roorkee; and also the establishment at the former station of a permanent observatory, under the direction of the gentleman whose observations of the late transit of Venus at Roorkee elicited so much admiration.—*The Homeward Mail*, May 24th, 1875.

A letter from a Telegraph Officer in camp in S. Punjâb mentions "a lot of falling stars, and a beautiful meteor whose trail faded away very gradually," seen on the evening of the 21st April. It is added, "the skies are lovely here,—I suppose the driest part of India: such moonlight!"

A magnificent meteor fell over the neighbourhood of Nungumbaukum (Madras), on Saturday evening (June 5th), about half-past seven o'clock. For a second or two it illuminated the whole neighbourhood with a brilliant bluish light.—*Madras Times*, *Overland Mail*, June 9th, 1875.

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* On the 31st December, 1860, the air being tolerably good, this nebula was seen by Dr. Pape and myself, though with difficulty, in the 9-foot equatorial of this place.
Altona: January 6, 1861. (Note by Dr. Peters).

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

CURIOUS COINCIDENCE IN 1769 TRANSIT.

Sir,—On the occasion of the latter transit of Venus in the eighteenth century, I find a curious coincidence. The observation seems to have had a narrow escape of being spoiled by an eclipse of the sun. The ingress of Venus on the sun took place an hour or so before sunset. The eclipse began about a couple of hours after sunrise. Both seem to have been observed in this country. The coincidence being within a few hours is sufficiently close to be worth noting. I do not remember to have seen it mentioned before.

Upton Helions Rectory. Faithfully yours,
S. J. JOHNSON.

SUNSETS AND THE ZODIACAL LIGHT.

Sir,—The phenomenon described by Canon Beechey, on p. 174, is not an uncommon one, though he seems to have seen a particularly good example of it. It is purely an atmospheric phenomenon, ascribed to the sun shining on particles either of water or of ice.

As to the alleged observation of the zodiacal light by Derham, mentioned on p. 147, I think there can be no doubt that, if the statement is correct that the light "appeared about a quarter of an hour after the sun set," it cannot possibly have been the zodiacal light, but was probably merely the pink tinge that so often appears on the sky at sunrise or sunset, which also is merely an atmospheric phenomenon.

Yours truly,
T. W. BACKHOUSE.

THE DOUBLE STAR 3 (κ) CENTAURI.

Sir,—This fine double star is rated 4 m. in Proctor's Atlas, and a small 2 m. (!) in Harding. It is now about 5 or 5½, and may possibly therefore be variable. Sir J. Herschel rated the components in 1836 as 6, 7½, distance about 9″. With a 3-inch refractor I see them white and light blue, with several faint and distant *comites* in a large field.

Your obedient servant,
J. E. GORE, M.R.I.A.

THE RING OF LIGHT AROUND VENUS DURING THE LATE TRANSIT.

Sir,—At the last meeting of the Royal Astronomical Society, reference was made by myself to a paper by Prof. Lyman, published in *Silliman's American Journal of Science* for January, 1875, giving an account of his observations of Venus when close to the sun's limb, and containing a determination of the horizontal refraction exerted by Venus's atmosphere upon the solar rays. In the report of the meeting in the June number of the

Astronomical Register, it should be read, not that the planet appeared surrounded by a delicate ring of light two days after the transit, but that it was seen "in part" so surrounded owing to a prolongation of the horns of the planet 50° beyond that directly illuminated by the sun.

The true nature of the ring of light around the planet, as seen during the late transit, is a question of very peculiar interest in connection with the numerous physical observations of Venus, and Prof. Lyman's observations are highly important in connection with this subject.

In so far as has at present been made known, all the observation of the bright ring round the planet points to its being due to the refraction of the sun's rays through the planetary atmosphere, and also indicate that this atmosphere must possess sufficient density to give a horizontal refraction of at least 10′, corresponding to a surface density of nearly one-half of our own. For unless the horizontal refraction was fully as great as this it would not account for the ring of light surrounding the planet being brighter than the solar limb, which could only occur through the rays refracted to the earth coming from near the centre of the solar disc. The probabilities are, however, that considering the great loss by absorption that the solar rays would undergo in traversing the low lying strata of the atmosphere of Venus, under these conditions the solar rays after traversing the planet's gaseous envelope, would be less brilliant than even the solar limb. Were the horizontal refraction of the atmosphere of Venus greater than some 13′, it is evident that at egress or ingress the rays that would reach the earth from the centre of the sun, where they would be most brilliant, would no longer pass through the layer of air near the surface of the planet, but even at their nearest point to the planet's disc would be slightly elevated above it, and the amount of this elevation above the surface increases directly as the horizontal refraction of the atmosphere of the planet. Also, the higher above the surface of Venus was the lowest layer of its atmosphere traversed by the solar rays, the brighter they would be after egress, as at a height of a few miles above the surface not only does nearly all the absorption cease, but the column of atmosphere traversed is much shorter, and little loss of light need therefore be feared when the solar rays traversed a region above that within which are located the surface vapours constituting the most powerful absorbent.

Now this is in agreement with the very accordant observations of Mädler and Lyman, referred to at the late meeting of the Royal Astronomical Society, as to the amount of the horizontal refraction of the atmosphere of Venus. Mädler, from measures by Clausius, in May, 1849, and published in the *Astronomische Nachrichten*, No. 679, 1849, deduced a value of 45′·3, and this value is quoted in several German works on astronomy, including Mädler's own *Populaire Astronomie*. In December, 1866, Professor Lyman, of America, with a fine 9-inch equatorial made a series of similar measures to Mädler's, and found for the horizontal refraction the value 45′·3 (*Silliman's American Journal of Science*, Jan. 1867, p. 129), though at this period he seems to have been unaware of the previous work of Clausius and Mädler. In 1874, after the late transit, the earliest opportunity that had presented itself, Lyman again with his 9-inch Alvan-Clark refractor, made a series of micrometrical measures, of the prolongation of the cusps of Venus, amounting in number to 47, and from these deduced 44′·5 for the horizontal refraction of the atmosphere of Venus (*Silliman's American Journal of Science*, January, 1875, p. 46). The mean of these three series of measures is 44′·5, which considering the powerful optical means must be considered from the accordant nature of the results, a tolerably approxi-

mate determination of the horizontal refraction of the atmosphere of the planet Venus; and indicates a density of atmosphere rather over a half as dense again as the earth. This result is in accordance with the condition indicated by the observation made during the late transit, which owing to the delicate silvery ring of light observed round the planet being brighter than the solar limb, shows that little light can have been lost by absorption in its passage through the atmosphere of the planet, and that therefore that the rays must have passed through atmospheric layers of considerable elevation above the surface. Now, if the horizontal refraction of the atmosphere of Venus is as indicated by the micrometrical measures of Mädler and Lyman, nearly 45′, then the rays from the centre of the sun falling on the earth after traversing the planet's atmosphere, would cross this at the nearest point to the surface of Venus, some six miles high, where the density of the atmosphere of Venus would be but little greater than one-third of that at the surface of the earth.

The only point which in any way militates against the almost conclusive evidence in favour of the origin of the bright line seen surrounding Venus being the atmosphere of the planet, is its disappearance almost immediately after the final egress, and generally before. It is evident that if the atmosphere of Venus is sufficiently dense to account for the ring of light observed, this ring cannot disappear under any probable conditions until some time after egress; so that here exists a point requiring consideration.

It was this circumstance which induced Mr. Cowper Ranyard at the last meeting to withdraw his suggestion as to the cause of the phenomena being light reflected from the clouds within the atmosphere of Venus; and, as before remarked, is the sole objection to the perhaps more simple view already adverted to.

Professor Lyman's observations are on this point of the greatest importance, for, as mentioned by myself at the last meeting of the Royal Astronomical Society, he saw Venus completely surrounded by a delicate silvery light over five hours before ingress; and there can be no question but that this ring and that seen around Venus at egress are identical in nature. In his paper in *Silliman's American Journal*, Professor Lyman says—"On Tuesday, December 8th, Venus was again in close proximity to the sun; and the writer had the satisfaction of witnessing the delicate silvery ring enclosing her disc, even when the planet was only the sun's diameter from the limb. This was at 4 p.m. or less than five hours before the beginning of the transit. The ring was brightest on the side towards the sun, the crescent proper. On the opposite side the thread of light was duller and of a slightly yellowish tinge."

These observations of Professor Lyman are exactly similar in nature to his early observations, made during 1866, of which he says—"the planet was then (for the first time, so far as appears) seen as a very delicate luminous ring. The cusps of the crescent as the planet approached the sun had extended gradually beyond a semi-circle, until they had at length coalesced and formed a perfect ring of light." Reference to Professor Lyman's original paper in *Silliman's Journal* for January, 1867 (Vol. xviii. p. 129), shows that this appearance was very distinctly seen with the fine 9-inch equatorial on December 10th, 1866, when Venus was 1° 8′ from the sun, and on December 12th, 1866, when 1° 36′ from the limb. This appearance was seen by other observers at the time, and is confirmed in the most complete manner by the measures of Clausius and Mädler which, from the value for the horizontal refraction found, show that this phenomenon must occur when the planet approaches within about 2° of the solar centre.

From these observations it would appear, therefore, that the ring of light around the planet, though after its egress no longer detected by any observer, did not vanish, and it remains only necessary to account for its not being seen by the observers, to remove the only difficulty in ascribing the bright ring of light around Venus to the refraction of the solar rays by the planet's atmosphere.

This silvery ring of light was of extreme delicacy, certainly under one second of arc in thickness, so as to render it a very delicate object that could only be seen with considerable trouble, remembering the difficulty in picking up Venus when very close to the edge of the sun, unless the field be very much constricted. When, therefore, the dark, black body of the planet had disappeared entirely on egress, and this very delicate silvery circle no longer sharply defined against the black planet, it must have been exceedingly easily overlooked, whilst, moreover, no observer appears to have even as much as looked for it under these conditions. The observation being made through a dark glass and in presence of the sun would also have very materially interfered with the detection of the thin delicate ring, and it must be remembered that Professor Lyman's observations were made when shielded from the solar rays and without a dark glass. As the planet increased its distance from the sun, the solar rays traversing rapidly increasing greater masses of atmosphere where the absorbtion of light would be much increased, would very soon render the ring of light much fainter than when on the the solar disc. To these causes conjointly, therefore, must probably be ascribed the very delicate light ring not having been noticed by the observers of the late transit of Venus; and considering the extremely delicate and difficult object that a remarkably thin circle of light over one minute in diameter must have presented in the very brilliantly illuminated field, and not either thrown up by contrast, or its place directly indicated by the black border of the planet, its not being noticed can excite no surprise.

Whatever may be the reason for this line of light, due to the refraction of the solar rays by the atmosphere of Venus, not having been seen by the observers of the late transit after egress; unless the careful micrometrical measures by Clausius, Mädler and Lyman be rejected, its existence cannot be questioned, nor that of the fact that this atmosphere must have produced a ring of light in every way exactly similar to that which was seen during the late transit of Venus.

E. NEISON.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN AUGUST, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXVI. British Association map, 60° to 65° S. latitude.

In this Zone from the moon's western limb to 35° west longitude, several unnamed craters are found. The 30th meridian passes through Mutus (400), which extends over five degrees; 13° further east Pentland (402). A little west of the first meridian the south part of Terra Photographica commences and terminates at the south-west part of Clavius (*a*) (193), Blancanus (260), Scheiner (261), the south part 10°, Bettinus (251), 7° Zuchius (250), which extends over five degrees. Ten degrees further east the western edge of Bailly an extensive walled plain near the south-eastern limb. It is figured by Mädler in "Der Mond," as seen 1835, November 14 and 15, and described in the text, p. 327, § 341.

Schröter gives two drawings of it, one as seen on October 13, 1788, with Wilson (253), Kircher (252), Bettinus (251), and Zuchius (250). The description of the floor and objects upon it will be found in Vol. II. of "Schröter's Fragments," p. 70, § 608. The second drawing was made on the 1st of August, 1792, it is described at p. 72, § 610 of Vol. II. of the "Fragments." These drawings may be advantageously compared with that by Mädler. It is very advisable that comparisons of the whole of these drawings with the moon should be made during the approaching autumn, as many good opportunities may be presented for so interesting a purpose.

(*a*) See the June list, No. 150, p. 148, for the Zones in which "Terra Photographica" occurs.

Great Cleft of Capuanus. We are now engaged on a map of the region of this cleft, having in our possession ten drawings, and shall be glad to receive further illustrations. The map will appear in the Third Issue of "Selections from the Portfolios of the Editor of the Lunar Map and Catalogue," and will contain objects not to be found in any other delineation extant.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat.	Angle of position of sun's axis.	
	°	°	°	°	
Aug. 1	265.04	13·24	+5·92	11·01	·40
2	278·28	·24	5·99	11·41	·39
3	291·52	·24	6·05	11·80	·39
4	304·76	·24	6·12	12·19	·39
5	318·00	·24	6·18	12·58	·38
6	331·24	·23	6·25	12·96	·38
7	344·47	·24	6·31	13·34	·38
—					
8	357·71	13·24	+6·37	13·72	·37
9	10·95	·23	6.42	14.09	·37
10	24·18	·24	6·38	14·46	·36
11	37·42	·23	6·53	14·82	·36
12	50·45	·24	6·58	15·18	·35
13	63·89	·23	6·63	15·53	·35
14	77·12	·24	6·68	15·88	·34
—					
15	90·36	13·23	+6·73	16·22	·34
16	103·59	·23	6·77	16·56	·34
17	116·82	·23	6·82	16·90	·33
18	130·05	·24	6·86	17·23	·32
19	143·29	·23	6·90	17·55	·32
20	156·52	·23	6·93	17.87	·32
21	169·75	·22	6·97	18·19	·31
—					
22	182·97	13·23	+7·00	18·50	·30
23	196·20	·23	7·03	18·80	·30
24	209·43	·23	7·06	19·10	·30
25	222·66	·23	7·09	19·40	·29
26	235·89	·22	7·11	19·69	·28
27	249·11	·23	7·13	19·97	·28
28	262·34	·23	7·15	20·25	·28
—					

29	275·57	13·22	+7·17	20·53	·27
30	288·79	·22	7·19	20·80	·26
31	302·01	·23	7·21	21·06	·26
Sept. 1	315·24	13·22	7·22	21·32	·25
2	328·46		7·23	21·57	

A.M.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF MARS.

Greenwich Midnight. 1875.	Areographical longit. of the centre of ♂'s disk.		Areographical latit. of the centre of ♂'s disk.	Angle of position of ♂'s axis.	Diameter.
	°	°	°	°	″
Aug. 1	206·4	+350·8	+3·03	32·58	18·28
2	197·2	0·8	2·97	32·53	18·14
3	188·0	0·8	2·90	32·47	18·00
4	178·8	0·7	2·82	32·40	17·86
5	169·5	0·8	2·73	32·33	17·72
6	160·3	0·8	2·63	32·25	17·58
7	151·1	0·7	2·53	32·16	17·44
8	141·8	350·7	+2·42	32·07	17·30
9	132·5	0·7	2·31	31·97	17·16
10	123·2	0·7	2·19	31·86	17·02
11	113·9	0·7	2·06	31·76	16·88
12	104·6	0·7	1·93	31·64	16·74
13	95·3	0·6	1·79	31·52	16·60
14	85·9	0·7	1·65	31·39	16·47
15	76·6	350·7	+1·50	31·25	16·34
16	67·3	0·6	1·34	31·11	16·20
17	57·9	0·6	1·18	30·96	16·07
18	48·5	0·6	1·01	30·81	15·94
19	39·1	0·7	0·84	30·65	15·81
20	29·8	0·6	0·67	30·49	15·68
21	20·4	0·6	0·49	30·32	15·55
22	11·0	350·6	+0·31	30·15	15·42
23	1·6	0·5	+0·12	29·97	15·29
24	352·1	0·6	—0·08	29·78	15·17
25	342·7	0·6	0·28	29·59	15·04
26	333·3	0·5	0·49	29·39	14·92
27	323·8	0·6	0·70	29·19	14·80
28	314·4	0·5	0·91	28·98	14·68
29	304·9	350·6	—1·12	28·77	14·56
30	295·5	0·5	1·34	28·55	14·44
31	286·0	0·5	1·56	28·32	14·32
Sept. 1	275·5	0·5	1·78	28·09	14·20
2	266·0	0·5	2·01	27·85	14·09
3	256·5	0·5	2·24	27·61	13·98
4	247·0	0·5	2·48	27·36	13·87
5	238·5		—2·72	27·11	13·76

A. MARTH.

ASTRONOMICAL OCCURRENCES FOR AUGUST, 1875.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage h. m. Saturn
Sun	1	1 27	● New Moon	2nd Sh. E.	10 13	13 5·3
Mon	2		Sidereal Time at Mean Noon, 8h. 42m. 41·60s.			13 1·1
Tues	3		Sun's Meridian Passage 5m. 57·0s. after Mean Noon			12 56·9
Wed	4					12 52·7
Thur	5			3rd Ec. D.	8 48 2	12 48·5
Fri	6			1st Oc. D.	9 3	12 44·3
Sat	7	0	Conjunction of Moon and Jupiter, 2° 45′ N.	1st Tr. E. 1st Sh. E.	8 36 9 47	12 40·0
Sun	8	15 30 4	☽ Moon's First Quarter Conjunction of Sun and Uranus	2nd Tr. I.	7 51	12 35·8
Mon	9		Saturn's Ring: Major axis=39″·82 Minor axis=7″·73			12 31·6
Tues	10	10	Conjunction of Venus and Mercury, 0° 15′ N.	2nd Ec. R.	7 49 50	12 27·4
Wed	11	19	Conjunction of Moon and Mars 0° 28′ N.			12 23·1
Thur	12			3rd Oc. D.	7 45	12 18·9
Fri	13					12 14·7
Sat	14			1st Tr. I.	8 21	12 10·5
Sun	15	13	Opposition of Saturn and Sun Illuminated portion of disc of Venus=0·983 Illuminated portion of disc of Mars=0·895	1st Ec. R.	8 48 48	12 6·2
Mon	16	13 33 10	○ Full Moon Conjunction of Moon and Saturn, 2° 32′ N.			12 2·0

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Tues	17		Sidereal Time at Mean Noon 9h. 41m. 49·94s.			11 57·8
Wed	18		Sun's Meridian Passage 3m. 42·49s. after Mean Noon			11 53·6
Thur	19	15 4 15 45 4	Occultation of 44 Piscium (6) Reappearance of ditto Conjunction of Mars and 3 Sagittarii 0° 8′ S.			11 49·4
Fri	20	13 26	Near approach of ζ^1 Piscium (4½)			11 45·1
Sat	21	17	Superior conjunction of Mercury and Sun			11 40·9
Sun	22			1st Oc. D.	7 29	11 36·7
Mon	23	13 38 15 58	☾ Moon's Last Quarter Near approach of 36 Tauri (6)	1st Sh. E. 3rd Sh. E.	8 6 8 37	11 32·5
Tues	24			2nd Oc. D.	8 25	11 28·3
Wed	25					11 24·1
Thur	26	13 59 14 45	Occultation of 47 Geminorum (6) Reappearance of ditto	2nd Sh. E.	7 16	11 19·8
Fri	27					11 15·6
Sat	28					11 11·4
Sun	29	22	Conjunction of Moon and Venus 2° 8′ S.			11 7·2
Mon	30	11 41	● New Moon Saturn's Ring: Major axis=42″·33 Minor axis=9″·71	1st Sh. I.	7 49	11 3·0
Tues	31	4	Conjunction of Moon and Mercury, 0° 47′ S.	1st Ec. R.	7 6 48	10 58·8
SEPT. Wed	1					10 54·6

THE PLANETS FOR AUGUST.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	7 32 20	N.21 20	6″·6	22 49·8
	9th	8 31 1	N.19 57½	5″·6	23 16·9
	17th	9 36 36	N.16 4½	5″·0	23 50·9
	25th	10 30 10	N.11 12½	4″·8	0 16·8
Venus ...	1st	7 51 2	N.21 31	10″·0	23 8·5
	9th	8 32 20	N.19 40½	9″·8	23 18·2
	17th	9 12 39	N.17 13½	9″·8	23 27·0
	25th	9 51 52	N.15 3	9″·8	23 34·6
Mars ...	1st	17 22 40	S.27 51	21″·8	8 42·5
	9th	17 28 12	S.27 45½	20″·4	8 16·6
	17th	17 17 11	S.27 40	19″·2	7 54·1
	25th	17 49 8	S.27 31	18″·0	7 34·5
Jupiter ...	1st	13 32 16	S. 8 25	33″·0	4 52·7
	9th	13 35 60	S. 8 48½	32″·2	4 25·6
Saturn ...	1st	21 46 11	S.14 54	16″·9	13 5·3
	9th	21 43 56	S.15 6½	17″·0	12 31·6
	17th	21 41 36	S.15 19	17″·0	11 57·8
	25th	21 39 17	S.15 31	17″·0	11 24·1

Mercury is visible at the beginning of the month, an hour and a half before the sun, the interval decreasing. On the 23rd he rises at the same time as the sun.

Venus is badly situated for observation, being visible for about an hour before sunrise at the beginning of the month, the interval decreasing.

Mars may be observed in the evening, setting at midnight at the beginning of the month, then earlier each night. He sets on the last day about four hours after sunset.

Jupiter sets two hours and a half after sunset, the interval gradually decreasing.

Saturn rises soon after sunset, and will be visible throughout the night.

EPHEMERIS OF THE SATELLITES OF SATURN.

The rectangular co-ordinates of the three inner satellites and the apparent distances of Titan and Japetus, are expressed in semi-diameters of the planet's equator.

$+x$ East of minor axis of ring. $+y$ North of major axis of ring.
$-x$ West " " " $-y$ South " " "

At 20h. Greenwich Sidereal Time.

1875.	Tethys.		Dione.		Rhea.		Titan.		Japetus.	
Aug.	x	y	x	y	x	y	pos.	dist.	pos.	dist.
1	+4·8	—0·3	+4·8	—0·9	+6·6	—1·3	255·5	10·9	270·3	44·2
2	—4·5	+0·5	—6·6	—0·2	—4·7	—1·6	266·6	16·5	270·5	40·7
3	+4·0	—0·6	+3·6	+1·1	—8·3	+0·7	272·8	19·7	270·8	36·9
4	—3·5	+0·8	+1·6	—1·3	+1·6	+1·9	277·9	20·1	271·1	32·9
5	+2·8	—0·9	—5·7	+0·6	+8·9	0·0	283·7	17·2	271·5	28·7
6	—2·0	+1·0	+2·4	+1·3	+1·6	—1·9	293·6	11·9	272·1	24·2
7	+4·8	—0·3	—2·1	—1·3	—8·3	—0·7	325·4	5·6	272·9	19·6

8	−0.3	+1·1	−3·1	+1·2	−4·6	+1·7	53·4	6·3	273·8	14·9
9	−0·6	−1·1	+6·3	−0·3	+6·7	+1·3	79·8	12·7	274·9	10·1
10	+1·5	+1·0	−5·1	−0·8	+7.1	−1·2	88·8	18·0	284·	5·2
11	−2·8	−1·0	+0·5	+1·4	−4·1	−1·7	94·3	20·8	356·	1·4
12	+3·0	+0·9	+4·5	−1·0	−8·6	+0·6	99·1	20·7	74·	5·1
13	−3·7	−0·7	−6·4	−0·1	+1·0	+2·0	104·7	17·7	81·4	9·9
14	+4·2	+0·6	+3·9	+1·1	+8·9	+0·1	114·1	12·6	84.1	14·7
15	−4·6	−0·4	+1·2	−1·4	+2·2	−1·9	140·2	6·6	85·5	19·4
16	+4·9	+0·2	−5·5	+0 7	−8·1	−0·8	221·1	5·6	86·4	24·1
17	−5·0	0·0	+6·1	+0·4	−5·2	+1·6	255·8	11·4	86·9	28·6
18	+4·9	−0·2	−2·5	−1·3	+6·2	+1·4	266·8	16·7	87 4	32·8
19	−4·7	+0·4	−2·8	+1·3	+7·4	−1·1	273·0	19·9	87·7	36·7
20	+4·3	−0·6	+6·2	−0·4	−3·5	−1·8	278·3	20·0	88·0	40·5
21	−3·8	+0·7	−5·3	−0·8	−8·7	+0·4	284·5	17·1	88·3	44·0
22	+3·2	−0·9	+0·9	+1·4	+0·4	+2·0	295·2	11·6	88·5	47·1
23	−2·5	+1·0	+4·2	−1·1	+8·8	+0·3	330·6	5·5	88·7	50·0
24	+1·7	−1·1	−6·4	0·0	+2·9	−1·9	55·2	6·7	88·9	52·5
25	−0·8	+1·1	+4·3	+1·1	−7·8	−1·0	80·0	13·1	89·0	54·6
26	−0·1	−1·1	+0·8	−1·4	−5·7	−1·6	88·9	18·2	89·2	56·3
27	+1·0	+1·1	−5·3	+0·8	+5·7	−1·6	94·6	20·8	89·4	57·7
28	−1·8	−1·1	+6·2	+0·4	+7·8	−1·0	99·6	20·5	89·6	58·7
29	+2·6	+1·0	−2·9	−1·3	−2·9	−1·9	105·6	17·5	89·7	59·3
30	−3·3	−0·9	−2·4	+1·4	−8·8	+0·3	115·7	12·3	89·9	59·5
31	+3·9	+0·7	+6·0	−0·5	−0·3	+2·1	144·5	6·4	90·0	59·3
Sept.										
1	−4·4	−0·5	−5·6	−0·7	+8·7	+0·4	224·0	6·0	90·2	58·6
2	+4·8	+0·3	+1·3	+1·5	+3·5	−1·9	256·1	11·8	90·4	57·6

Approximate times of the conjunctions of the satellites with the centre of the planet, or of their passing in the direction of the minor axis of the ring.

Gr. Sid. Time.				
		h.		y
Aug.	1	4·8	Dione	−1·4
		5·5	Tethys	−1·1
	2	10·5	Rhea	−1·9
		4·2	Tethys	+1·1
	3	13·7	Dione	+1·4
		2·9	Tethys	−1·1
	4	16·8	Rhea	+1·9
		22·6	Dione	−1·4
		1·6	Tethys	+1·1
	5	0·3	Tethys	−1·1
		7·6	Dione	+1·4
	6	23·0	Tethys	+1·1
		23·1	Rhea	−1·9
	7	16·5	Dione	−1·4
		21·7	Tethys	−1·1
		6·8	Titan	+4·3
	8	20·4	Tethys	+1·1
		1·4	Dione	+1·4
		5·4	Rhea	+1·9
	9	19·1	Tethys	−1·1
	10	10·3	Dione	−1·4
		17·8	Tethys	+1·1

Gr. Side Time.			
	h.		y
11	11·8	Rhea	−2·0
	16·6	Tethys	−1·1
	19·2	Dione	+1·4
	? 21	Japetus	+1·4
12	15·2	Tethys	+1·1
	4·1	Dione	−1·4
13	14·0	Tethys	−1·1
	18·1	Rhea	+2·0
14	12·7	Tethys	+1·1
	13·1	Dione	+1·4
15	11·4	Tethys	−1·1
	22·0	Dione	−1·4
	0·4	Rhea	−2·0
16	10·1	Tethys	+1·1
	10·5	Titan	−4·6
	6·9	Dione	+1·4
	8·8	Tethys	−1·1
17	6·7	Rhea	+2·0
	7·5	Tethys	+1·1
18	15·8	Dione	−1·4
	6·2	Tethys	−1·1
19	0·7	Dione	+1·4

	4·9	Tethys	+1·1
20	13·0	Rhea	−2·0
	3·6	Tethys	−1·1
	9·6	Dione	−1·4
21	19·1	Enceladus just north of the ball.	
	2·3	Tethys	+1·1
22	11·6	Encel.	−0·9
	18·5	Dione	+1·4
	19·3	Rhea	+2·0
	1·0	Tethys	−1·1
	4·1	Encel.	+0·9
23	20·6	Encel.	−0·9
	23·7	Tethys	+1·1
	3·5	Dione	−1·4
	5·4	Titan	+4·5
24	13·1	Encel.	+0·9
	22·5	Tethys	−1·1
	1·6	Rhea	−2·0
	5·5	Encel.	−0·9
25	12·4	Dione	+1·5
	21·2	Tethys	+1·1
	22·0	Encel	+0·9
26	14·5	Encel	−0·9
	19·9	Tethys	−1·1
	21·3	Dione	−1·5
	7·0	Encel	+0·9
	7·9	Rhea	+2·0
27	18·6	Tethys	+1·1
	23·5	Encel.	−0·9
	6·2	Dione	+1·5
28	16·0	Encel.	+0·9
	17·3	Tethys	−1·1
	8·4	Encel.	−0·9
29	14·2	Rhea	−2·1
	15·1	Dione	−1·5
	16·0	Tethys	+1·1
	0·9	Encel.	+0·9
30	14·7	Tethys	−1·1
	17·4	Encel.	−0·9
	0·0	Dione	+1·5
	9·9	Encel.	+0·9
31	13·4	Tethys	+1·2
	20·6	Rhea	+2·1
	2·4	Encel.	−0·9
	9·0	Titan	−4·8
	9·0	Dione	−1·5
Sept. 1	12·1	Tethys	−1·2
	18·9	Encel.	+0·9

When y is positive, the satellite moves from the preceding to the following side: when y is negative, the satellite moves from the following to the preceding side. Observers will oblige by communicating the true times of any of these conjunctions, especially that of Japetus on Aug. 11.

A. M.

The Gresham Professorship of Astronomy was filled up on Tuesday, July 27th, by the appointment of the Rev. E. Ledger, Rector of Duxford, Cambridgeshire. There were thirteen candidates, including Mr. Norman Lockyer, F.R.S., Mr. J. W. L. Glaisher, F.R.A.S., Mr. G. F. Chambers, F.R.A.S., &c.

TO CORRESPONDENTS.

We are obliged to postpone our list of Subscriptions received.

When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 153. SEPTEMBER. 1875.

D'ARREST.

Among the many eminent astronomers whom death has taken away from us within a very recent period, none is more to be regretted than the subject of this notice. Some of them, like Argelander and Schwabe, died full of years and fame, but the career of D'Arrest was cut short long before the accomplishment of what his genius and his labours might lead us to expect.

HEINRICH LOUIS D'ARREST,

born in Berlin, on August 13, 1822, died at Copenhagen, on June 14, 1875, at 6 o'clock a.m.

He was descended from a French family that was forced to leave its native country in consequence of the revocation of the Edict of Nantes in 1685. In his early youth he studied at the French College in Berlin, where he received lessons from Encke, who made him his second assistant in 1846. Two years after this he was appointed to the observatory at Leipzig, where he received a Doctor's degree *honoris causa*, and subsequently became a professor of mathematics and astronomy. At this period he made his comet discoveries, and commenced his observations of the nebulæ. In 1851 he wrote his notice of the system of the minor planets, and in 1856 he published the results of his work at the nebulæ and clusters. In 1857 he was called to Copenhagen as professor in the university, while he superintended the building of the observatory to which he was appointed director. In 1862 he discovered FREIA. In 1867 he published, at the cost of the Copenhagen Academy, his *Siderum Nebulosorum Observationes.* He next applied himself to spectral analysis, and in 1872 he wrote in the Danish language his work on the spectral characteristics

of nebulous stars, entitled, *Undersögelser over de nebulose Stjerner i Henseende til deres spectralanalytiske Egenskaber.* He wrote a good deal in scientific serials, and particularly in the *Astronomische Nachrichten.* In that journal appears his last work, where he describes several newly-discovered objects exhibiting the 3rd and 4th types of Secchi's star spectra, and it is worthy of remark that in the same number (2044) where he completes the record of his observations we find the announcement of his death. His last communication is dated *June,* and must have been written very few days before his illness. He never expected to be a long liver, and with a peculiarly nervous temperament, he suffered from a hypochondriasis, which increased year after year. He had been long complaining of his health, and, though without any organic disease, his fancied ailments were in the end not less fatal.

NEW OBSERVATIONS UPON THE SPECTRA OF FIXED STARS.

By Father Secchi, of Rome.

(From the *Compt-rendu, Vol.* 44, *p.* 775.)

I have shown from previous observations that the spectra of the fixed stars may be referred to three characteristic types, the representatives whereof are, firstly, *a Lyræ* (*Wega*), secondly, *a Herculis,* thirdly, *a Bootis* (*Arcturus*), or by our Sun itself. Between the first and the last type, almost all the stars hitherto examined may be divided, and this in tolerably equal numbers.

These results warranted their being confirmed by more comprehensive and numerous observations, and this I have done. An examination of about 500 of the principal stars in the heavens has just been concluded at the observatory of the *Collegio Romano,* with a detailed description of more than 400 of them. The results are identical with those arrived at already by the examination of a lesser number.

The pecularities of these comparisons are of equal interest in detail. The first type, *a Lyræ,* contains as fundamental lines two very visible hydrogen lines, that is to say, the one in the blue coinciding with the solar line *f,* and one in the violet at a position which, as far as I can infer from an examination of the spectrum of hydrogen as given by Professor Plücker, coincides with the line Hγ. The line Ha or C is seldom visible, for in this type the red is either altogether wanting, or at any rate very feeble.

The pecularity indicated by Plücker that the hydrogen lines

$H\beta$ and $H\gamma$ are rendered wider by an increase of temperature is shown in these stars by the fact that those two lines are occasionally very wide, and that the one in the violet is always of greater dimensions than the one in the greenish blue. In some stars these lines are somewhat diffuse, and this is what Plücker has found to be the case with the hydrogen lines at considerable temperatures and tensions.

It appears, therefore, from these details that hydrogen forms the chief constituent of stars of this group. The singular phenomenon exhibited by γ Cassiopeiæ wherein f instead of being a dark line is a bright one, might even be accounted for by the fact that hydrogen at low temperatures affords a continuous spectrum in which the line f is bright, and that hydrogen when present in small quantity does not invert the spectrum. There are doubtless yet other lines between those due to hydrogen, but they are relatively speaking very faint; those of magnesium and sodium are those that predominate.

The second type, that of *α Herculis*, is far less numerous, but of remarkable constancy. Direct measures give, at precisely the same place, the same lines in all stars of this type. The only difference consists in this, that in the case of normal stars, *α Herculis*, *β Pegasi*, *ο Ceti*, *ρ Persei*, &c., the lines dividing the columns are perfectly black and sharp, while in some other stars, as for instance *α Orionis*, *α Scorpionis*, &c., these lines occur somewhat faintly in the less refrangible portion of the spectrum. This peculiarity might lead to the idea of an essential difference between them, which, however, does not in fact exist.

It is very remarkable that the deep red-coloured stars and the variable are included in this type. The star *ο Ceti* (*Mira*) is a striking example of this. I observed it in September of last year (1866?), but its faintness at that time did not permit me to draw a conclusion. In March it had already attained a fourth and fifth magnitude, when it exhibited the colonnade of *α Herculis* with surprising accuracy; owing to its faintness, however, the spectrum appeared shorter, and the lines at the extremity were situated closer together. The red star in *Auriga* (*Lalande*, 12,561, R.A. 6h. 27m., Decl. 38° 33′) belongs also to this type, only that the second and third column are joined together so as to form but one, as are also the fourth and fifth. It is certainly astonishing to meet with such an identity in the spectra of stars so different. I conceive the stars belonging to this type to be tolerably numerous; their colour is however so deep that their character cannot be determined.

The third type, which is that of our sun, appears from its

nature to present of necessity a great number of differences, and yet this is not the case. The chief differences amount to this, that they show fine lines in more or less closely compressed bundles, but these lines occupy the same positions, which are not the same as those of the preceeding type. The magnesian line, which is strongly developed in the third type, does not exhibit the same association of neighbouring lines, as is the case in the second type; moreover, in the third type the line f is always to be made out with facility, whereas it is wanting in the second type. Owing to this distinction it is easy to distinguish this type from the other one, even when the lines are so grouped that there is a similarity between them. The doubtful cases that I have met with will be easily solved by further measures to be made when I have leisure.

Certain types are especially characteristic of particular regions of the heavens, even when the number of the stars is tolerably great. The *Orion* type characterises a portion of the constellations *Canis Major* and *Lupus*, whereas in other parts of the heavens it very rarely occurs; in these stars the green which is peculiar to nebulæ, is predominant. Yellow stars which are referable to the third types, are very numerous in *Cetus* and *Eridanus*. *Taurus*, with the exception of *Aldebaran* and a few other stars, consists entirely of those of the first type.

The following table shows the position of the principal lines in these three types of stars compared with those of our sun, and as it may be also done with the same instrument with regard to Venus and Mars.

Position of the principal Lines in the Spectra of the Planets and Fixed Stars. (In parts of the Micrometer.)

Venus.	Mars.	α Hercul.	β Pegas.	α Orion.	Arct.	Mira Ceti.	Wega.	α Persei.
A = 1,72				1,98				
B = 2,16					2,13			
C = 2,50		u' = 2,48	2,57	2,64				
D[1]) = 3,22	3,24	a = 3,25	3.22	3,22	3.38	3,18	3,12	
δ = 3,51		b = 3,86	3,83			3,90	3,62	
E = 4,83		c = 4,24	4,19	4,15	4 77	4,31		4,86
b^2 = 5,09	5,14	d = 5,11	5,11	5,11	5,09	5,11		
X = 5,62		e = 5,95	5,99	5,95				
F = 6,27	6,35	f = 6,81	6,85	6,78	6,21	6,77	6,28	6,30
G = 7,98	8,01	g = 7,64	7,68	7,49	7,98	8,15		
H = 9,40	9,64			8,43	9,65		9,15	8,29
W =							11,03	

From this table, as accurately as it can be established by a comparison of the principal lines, there is rendered evident an identity among the stars of a red colour, and also among the yellow stars and our sun. In a similar manner the table shows the difference in the position of the lines in the white stars of the type of Wega.

It is singular that red stars of the seventh magnitude, such as *Lalande*, 12,561, should give a spectrum capable of measurement, while this is not so with white stars of a similar magnitude. This is to be attributed to the lower dispersion of their light, whereby divided bright lines arise, as in the case with nebulæ. Even a faint light that is not dispersed maintains a remarkable intensity. Thus I could see the sodium lines well divided in the flame of a small ordinary candle at the distance of an English mile and a quarter.

It is, however, proper to observe that in the case of red stars the dark lines, strictly speaking, are stripes or bands, similar to those that the absorption of our atmosphere produces in the light of the sun. Thus the line D is very much widened out, far more than the fine sodium line. This is a proof that these stars are surrounded by atmospheres the absorption of which is very marked, the nature of which will not be established until chemists have separated in their spectra what belongs *to the nature of the substance* from that which is *due to their temperature.*

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*ON THE REPELLENT FORCES OF COMETS**

More than ten years after the appearance of Comet III., 1862, now rendered famous by its relations with the swarm of meteoric bodies we are accustomed to observe in the month of August, Sig. G. A Schiaparelli published his observations on this heavenly body, which lead him to the conclusion that the phenomena of comets demand, for their explanation, the assumption of a repellent force within them. Before communicating to our readers these conclusions of Sig. Schiaparelli, we will lay before them some interesting details from his journal of observations.

Sig. Schiaparelli observed the comet from the 24th of July to the 31st of August, with only few interruptions, caused by unfavourable weather, and only saw it again afterwards on the 7th and 14th of September. The head of the comet increased in brightness up to the 31st of August, not at an equal rate, but in periods of quicker and slower growth; pauses occurring between. Its diameter decreased with approach towards the sun. The comet passed through its perihelion on the 23rd of August, but important changes of volume occurred during the time of observation. On the very first sight of it a nucleus was visible; the farther the comet was distant from the sun, the more bright and the less sharply defined the nucleus became. Two days after the passage through the perihelion, it was reduced to the size of a star of the tenth magnitude. Within the

* Translated from *Der Naturforscher* for 20th March, 1875.

head there was observed, from the 17th, a radiation of light emanating from the nucleus, which was in an opposite direction to that of the train or tail, and which, during the time of observation, showed a series of transformations and local changes; in September it was no longer seen. From the 30th of July to the 7th of August there was, besides the chief train, another secondary one visible, which formed with the former a fairly constant angle of some 60°. The chief train was not visible to the naked eye till the 17th of August (between the 14th and 17th the comet was not visible); on the 20th it showed a division into two, and on 21st a division into three trains or tails; their direction in the vicinity of the head formed an angle which remained constant with the radius vector of the comet; its curvature was such that the convex side of the tail was turned towards the region whence the comet came.

After these remarks regarding the particular peculiarities of this interesting comet, the general reflections may be introduced with which Sig. Schiaparelli connects the discussion of his observations:—

"Since, in these latter times, a belief has obtained that the phenomena of comets can be explained without pre-supposing a repellent power, it will not be out of place to recapitulate here the observations which cause me to assume such a force.

1. The very fact of the formation of trains, which could in no wise commence their developement without some force differing from gravitation, at least not in such a way as it is generally observed. There is a well-known theory according to which Lehmann (in the year 1822) tried to deduce the formation of trains in the same way as tides orignate. To the objection, however, which was raised from the absence of a train in the direction towards the sun (if the train were a tidal phenomenon there would *always* evidently have to be a second train in the direction towards the sun) Lehmann had nothing to oppose but the arbitary hypothesis of an eccentric position of the centre of gravity of the nucleus, which he always transposed to that part of the comet which was nearest the sun. And M. Roche, who in the fifth volume of the Annals of the Observatory of Paris lays down a similar theory, simply admits it to be impossible to account for the formation of trains, without assuming a repellent force, which would show its effect in the elongation of the radius vector.

2. The course which the trains take in space. With regard to this it will suffice to point to the theory of Bessel, to which the appellation of an hypothesis is wont to be given, although it is nothing but an examination which draws mathematical consequences from observed facts, the truth of which no one can afford to doubt, who considers the nature and weight of his arguments. From the researches of Bessel on the comet of Halley and from the analogous researches of Pape on the comet of Donati, the existence of a force opposed to the direction of the sun follows with the same certainty with which we can conclude, from the motion of heavy bodies thrown in a slanting direction, the existence of a force acting towards the centre of the earth. If we wished to avoid these consequences, we should have to assume either that the laws of common mechanics do not apply to the matter of comets, or that the light of the trains is derived from something incorporeal or immaterial.

3. Related to the foregoing, although essentially different, is the argument furnished by Comet III., 1862, the train of which was hurled forward in a direction which greatly differed from that of the radius vector, and which in retreating from the nucleus approached more and more the direction of that of the radius. In using this argument the existence of a repelling force directed against the tail no longer requires for its proof a calculation, but only a simple and very easily intelligible

consideration. [Sig. Schiaparelli shows in his discussion of his observations, that the tail is hurled forth by a force from the comet, tending towards a definite fixed direction, and is then repelled by the sun.]

4. The course of the radiations of light, which are hurled forth from the nucleus, and thrown to the rear, in order to form parts of the tail. Here, likewise, the existence of a repellent force is proved by a phenomenon which in a direct way makes the effects of that force apparent without requiring any subtile researches for the purpose.

5. Lastly, the repellent force shows itself not only between the sun and the tail, but also between the particles which compose the tail or tails, as has been pointed out above (from the spreading of the tails as they recede from the nucleus).

Now, after the repellent force has been proved, its measurement might be asked for. Its relative computation has been carried out by Bessel and Pape in their researches, mentioned as above, under the hypothesis that the development of the tail had taken place in the plane of the orbit. This assumption was surely not far from the truth, neither for the comet of Halley, nor for that of Donati. With regard to the comet of 1862, however, it is, on the whole, probable that the tail had developed itself outside of the plane of the orbit; the plane of the original curve of the tail is altogether unknown, it therefore becomes impossible to draw from the apparent form of a comet a conclusion as to its true form. There is, consequently, the first and most necessary basis wanting for computing the repellent force.—(Taken from *Publicazioni del Reale Osservatorio di Brera in Milano*, No. II.)

FLAMSTEED.

The first observation which Flamsteed has recorded in his *Historia Coelestis Britannica* as having been made by him at Greenwich (presumably at the Queen's house) seems to be that of an occultation of ζ Arietis (stella 10 mag. Tychonis) on the evening of Sept. 26 (old style), 1675.

Some readers, who take an interest in old sketches of Mars, may perhaps like to have their attention called to one given by Flamsteed in his *Hist. Coel.* and made at Derby, on October 11, 1672: "Planetae semper circa medium obscuritas aliqua apparuit, quam ut potui in 35ª Figura adumbravi."

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

ATMOSPHERE OF VENUS.

Sir,—In glancing over Mr. Neison's letter on this subject in the current number of the *Astronomical Register*, I thought that he did not appear to discriminate between the effects observed by Prof. Lyman, and those noted during transits of Venus. I was then about to leave town, and had intended on my return to read Mr. Neison's letter again, and note any points which might be misinterpreted; but my return has been delayed, and I now write without the *Register* to refer to. Quite possibly Mr. Neison's letter is not open to misconception when carefully read, and

certainly one who has given so much attention as Mr. Neison to the subject of planetary atmospheric refraction has not probably himself made the mistake I refer to as likely, perhaps, to be made by some who read his letter. The point is this :—Prof. Lyman observed the extension of the cusps of Venus's crescent, as the planet approached inferior conjunction, until at length the cusps closed, when a complete ring of light was seen round the dark disc of the planet. This ring of light was entirely due to the illumination of the planet's surface by sunlight. Where the ring was broadest the surface was directly illuminated, and where the ring was narrowest parts of the planet's surface, not in direct sunlight were illuminated by refracted sunlight. But the arc of light seen during the transit was not the illuminated surface of the planet—it was refracted sunlight itself. It need hardly be said that when the planet was off the solar disc the portion of the planet's limb *nearest* to the sun could not possibly show *such* light. The arc of refracted sunlight would be on the side furthest from the sun, and limited by the prolongations of two lines drawn from Venus's centre to touch the sun's disc. The illumination of the surface seen by Lyman would of course be quite invisible to observers using darkening glasses, as the observers of the transit did.

It seemed to me also that another part of Mr. Neison's letter was open to misconception. According to my recollection, he states that, assuming the horizontal refraction of Venus's atmosphere to be 45′, the refracted sunlight (or the expansion of the illuminated surface, I forget which—but what would be true of one would in this respect be true of the other) ought to be perceived when Venus was about 2° from the sun. There is some error here. In the case of an object placed like the moon so that the distance from the earth is very small compared with the sun's distance, we obtain the maximum distance at which the sun's light would be better refracted, by doubling the horizontal distance, and adding the sun's semi-diameter. This if applied to Venus would give rather more than 1¾°. But Venus's distance being considerable, we cannot apply this method. Obviously we must reduce the angle just mentioned by the angle which the line joining Venus and the earth subtends at the sun's centre, or approximately by about $\frac{2\,(\text{♀'s dist. from ⊕})}{\text{⊕'s dist. from ☉}} \cdot 45'$, *i.e.*, by about 25′, making the angle about 1⅓° instead of 2°.

As I sail from Liverpool for New York on October 2, I shall probably not see Mr. Neison's reply to this (should he reply) for some time. I note this lest his reply should be such that courtesy would render some answer from me desirable. Believe me, yours truly,

R. A. PROCTOR.

ON THE CHANGES OF COLOUR IN CAPELLA.

In Mr. Lockyer's *Elementary Astronomy* Capella is stated, on the authority of Mr. Ennis, to be a blue star. Such it has never appeared to me. That star, however, seems to be subject to decided and very remarkable changes of colour, and to a great extent of magnitude too, as recorded in the observations made in 1855 by Mr. B. Ellner, of Bamberg, in Bavaria. As Capella is now coming well into view, the attention of the readers of the *Astronomical Register* may, without impropriety, be called to the behaviour of that star. The observations of Mr. Ellner are to the following effect:—

"Observations of Capella in the year 1855.—The observations were carried on in clear and moonless nights during the entire year, partly

with the naked eye and partly with the aid of a telescope with achromatic object-glass and provided with an eye-piece the achromatism of which was complete. In observing the magnitude and the tone of colour of this star I did not fail to pay due attention to all the conditions laid down by Dr. Argelander in his well-known article upon the observation of the tone of colour of heavenly bodies with the naked eye. With respect to the value of the numbers, I have uniformly indicated the magnitude of the star in such a way, by means of a decimal fraction, that the gradations from the first to the second magnitude are expressed by corresponding tenths.

1855.				CAPELLA.	
9 Jan.	6h.	10h.	Night.	Mag.	1·7 yellowish red.
14 „	5h. 45m.,	10h.	„	„	1·9 yellowish red.
21 „	6h.		„	„	1·9 deep yellowish red.
12 Feb.	8h. 45m.		„	„	1·8 lead coloured.
18 „	8h. 30m.,	10h.	„	„	1·8 ditto.
11 Mar.	7h. & 9h.		„	„	1·2 yellow, with a deep reddish tint.
20 „	8h. & 11h.		„	„	1·2 pale reddish.
17 Apl.	9h.		„	„	1·1 light yellow.
12 „	9h. & 10h.		„	„	1·1 light yellow.
19 „	11h.		„	„	1·1 light yellow.
20 „	11h.		„	„	1·0 whitish yellow, flaming up of a reddish colour at very short intervals.
26 „	4h.		Morning	„	1·0 as above.
27 „	4h.		„	„	1·0 as above.
30 „	4h. 6m.		„	„	1·0 as above.
13 May	9h.	10h.	Night.	„	1·1 light yellow.
14 „	9h.	10h.	„	„	1·0 red.
15 „	9h.	11h.	„	„	1·0 red.

During the whole of June, July and August, towards midnight, when there was no moonlight, fire-red, with a continual flaring up of reddish light, like that of strontian, with the emission of flashing rays from the deepest red to fiery yellow.

1 Sept. 8h. & 8h. 30m., fire red, now and then of a livid colour for instants; magnitude, from May 16 till September 8, almost uninterruptedly 1·0, and so on, in the absence of the moon, up till the 1st of October.

17 Oct.	2h.		Morning.	„	1·0 fire red.
8 Nov.	10h.		Night.	„	1·0 leaden white, with a very delicate tinge inclining to pink.
11 „	10h. 30m.				*(deest.)*
12 „	7h.	9h.	„	„	1·0 more of the whitish light, toned with pink.
13 „	7h.	9h.	„	„	1·0 pink, and so on till December in clear moonless nights, both by night and at morning.
3 Dec.	5h.	7h.	„	„	1·0 pink.
16 „	5h.	6h.	Morning.	„	1·1 pink, with flashes of yellow at considerable intervals.
18 „	6h. 30m.		„	„	1·1 pink, flashing up intensely with fiery yellow.
19 „	5h. 45m.		„	„	1.1 reddish yellow."

The above observations by Mr. Benedict Ellner, are translated from Dr. G. A. Jahn's *Unterhaltungen im Gebiete der Astronomie, Geographie, und Meteorologie*, No. 17, 1856.

A. B.

ASSYRIAN AND BABYLONIAN ASTRONOMY.

In the division of tablets relating to astronomy and astrology, there are many new and curious tablets. Some of these give us our first insight into the divisions of the heavens and positions of the fixed stars. One shows that the sky was divided into four regions, the passage of the sun through which marked the four seasons of the year. This fragment is the most valuable astronomical test that has yet been discovered, as it shows also the method of arranging the year. The following is a translation of the inscription, with some slight restorations, which are easily supplied by the regular character of the text:—

1. From the 1st day of the month Adar, to the 30th day of the month Iyyar, the sun in the division (or season) of the great goddess, 2, is fixed and the time of showers and warmth. 3. From the 1st day of the month Sivan to the 30th day of the month Ab, the sun is in the division (or season) of Bal is fixed and the time of crops and heat. 5. From the 1st day of the month Elul to the 30th day of the month Marchesvan, the sun, 6, in the division (or season) of Anu is fixed, and the time of showers and warmth. 7. From the 1st day of the month Kislev to the 30th day of the month Sebat, the sun in the division (or season) of Hea is fixed, and the time of cold. 8. When on the 1st day of the month Nisan, the star of stars and the moon are parallel, that year is right (or normal). 9. When on the 3rd day of the month Nisan, the star of stars and the moon are parallel, that year is full (*i.e.*, has 13 months).

It appears by this that at the time this tablet was written, the spring quarter was counted as extending through the months Adar (the last month of the year), Nisan (the first month), and Iyyar, that is commencing in February and ending in May.

The summer quarter extended through the months Sivan, Tammuz, and Ab, commencing in May and ending in August. The autumn quarter extended through the months of Elul, Tisri, and Marchesvan, commencing in August and ending in November. The winter quarter extended through the months Kislev, Tebet, and Sebet, commencing in November and ending in February. To agree with and precisely mark these periods, the heavens were divided into four regions, and the passage of the sun from one of these to another served to mark the change of season. In this tablet I have, according to usual custom, translated the signs for "month" and "day," but I believe in this case the word "day" means a degree of the heavens, and the word "month" a sign of the zodiac, so that instead of "From the 1st day of the month Adar to the 30th of the month Iyyar," I should propose "From the 1st degree of the sign Pisces, to the 30th degree of the sign Taurus," and so on through the translation. The Assyrian year consisted, like the Jewish, of twelve lunar months, and in order to keep it in proper relation to the solar year, an intercalary month was sometimes added. In order to know when to add the extra month, they watched a star called the "star of stars," which was just in advance of the sun when it crossed the vernal equinox. If the moon was parallel with that on the 1st day of the month, they made no intercalation, but if it did not reach the star until the third day it showed that the year (from the fact that twelve lunar months were

short of the solar year) began too far in advance of the equinox, and therefore an intercalary month was added to bring it round again. The information with respect to the divisions of the heavens, and the names of some of the stars in the different divisions, will enable us in time to give something like precision to our knowledge of the Babylonian astronomy. I have been able already with these aids to fix approximately, and in some cases to identify, about thirty of the principal stars. Four of these are given on the fragment of the astrolabe, the stars Urbat and Addil, which were in the sign Scorpio, and the stars Nibat-anu and Udka-gaba, which were in the sign Sagittarius. The star Nibat-anu has hitherto been erroneously supposed to be a planet.

The fact that in this record the four quarters of the heavens do not commence with the new year, suggests the inquiry whether from the precession of the equinoxes the seasons had shifted since the first settlement of Babylonian astronomy. Another curious document of this class is an astrolabe, part of which I discovered in the palace of Sennacherib. In this the heavens and the year are represented by the circular form of the object, and round the circumference it was originally divided into twelve parts corresponding to the twelve signs of the zodiac, and the twelve months of the year, the number of degrees in each being marked. Inside these there were twelve other divisions nearer the pole, forming a second and inner circle, and in each of the twenty-four divisions the principal prominent star is inserted. The following diagram will give an idea of this work, remembering that the Assyrian copy is round a circle:—

Outer-circle.

Arah-uru-gab-a. *Month, Marchesvan.* (October.) Star Ur-bat. 140 degrees. *	Arah-gan-yan-na. *Month, Kislev.* (November.) Star Nibat-anu. 120 degrees. *
Star Addil. 70 degrees. *	Star Ud-ka-gab-a. 60 degrees. *

Pole.

I am of opinion that the numbers under the month of Marchesvan, 140 and 70 degrees, are errors in the Assyrian copy, and should be 150 and 75 degrees. These and some other similar documents will be of great value towards arranging the Babylonian names of stars, and ascertaining their divisions of the heavens. All investigations into the astronomy of the Assyrians and Babylonians are of little use until the positions of the stars according to their system are fixed.

In the valley of the Euphrates there were in those days observatories in most of the large cities, and professional astronomers regularly took observations of the heavens, copies of which were sent to the king, as each movement or appearance in the heavens was supposed to portend

some good or evil to the kingdom. The following report was found in the palace of Sennacherib at Konyunjik :—

1. To the king my lord, thy servant Abel-istar. 2. May there be peace to the king my lord. May Nebo and Merodach, 3. to the king my lord be favourable. Length of days, 4. health of body, and joy of heart, may the great gods, 5. to the king my lord grant, concerning the eclipse of the moon, 6. of which the king my lord sent to me ; in the cities of Akkad, 7. Borsippa and Nipur, observations, 8. they made and then in the city of Akkad, 9. we saw part. . . . . 10. The observation was made and the eclipse took place. 11. . . . . . 12. . . . . . The eclipse over . . . . . 13. . . . . . saw ? . . . . . 14. which on the tablet was written. . . . . . 15. I made the observation. . . . . . 16. This to the king my lord I send. 17. And when for the eclipse of the sun we made, 18. an observation, the observation was made and it did not take place. 19. That which I saw with my eyes to the king my lord, 20. I send. This eclipse of the moon, 21. which did happen, concerns the countries, 22. with their god all. Over Syria, 23. it closes, the country of Phœnicia, 24. of the Hittites, of the people of Chaldea, 25. but to the king my lord it sends peace, and according to, 26. the observation, not the extending, 27. of misfortune to the king my lord, 28. may there be.—*Assyrian Discoveries, &c., &c.*, by George Smith, 1875, pp. 404—410.

The principal incident in these legends, and the most important one in relation to the Bible, is the account of the flood. Izdubar (supposed to be Nimrod) is mourning for his seer, Heabani, and deploring his inability to replace him, when he resolves to seek the advice of Hasisadra, or Xisithrus, the sage who escaped the flood (Noah).The journey of Izdubar in search of Xisithrus is curious as showing that the Babylonians, although learned in some things, had no knowledge at this time of geography. They held the idea that at a little distance from them there were giants, who controlled the rising and setting sun, and that the orb of day was looked after and sent on in its course by these beings, who had their feet in the lower regions of hell while their heads touched and probably upheld the heaven. Izdubar, after journeying through various fabulous regions, at last coming in sight of Hasisadra and his wife, after some general remarks about life and death, goes on to tell him the story of the deluge.—*Ibid* p. 207.

A FRAGMENT OF ASTRONOMY IN "THE ARABIAN NIGHTS."

While comparing lately the Boulak edition of the Arabian Nights with Lane's excellent translation, I noticed for the first time the following passage occurring in the 756th night : "Fáris the Wezeer of the king of Egypt answered, 'We worship the sun, and prostrate ourselves to it.' Asaf therefore replied, 'O Wezeer Fáris, verily, the sun is a star, of the number of the stars created by God [Inna al-shams kaukab min jumlat al-kanakib al-makhlukat li'llahi] (Whose perfection be extolled, and whose name be exalted!), and far be it from being a lord! for the sun appeareth at times, and is absent at times, and our Lord is always present, never absent, and He is able to effect everything." (Lane 3, pp. 311, 312.) If it may be reasonably assumed that these famous tales have been circulated in their present form since the commencement of the 16th century (see Lane 3. p. 739) the above analogy between sun and stars is rather interesting. Those who in Cairo and elsewhere listened to or read this passage had, so far, more just views of the universe presented to them than probably most of even the educated contemporary inhabitants of

Europe for a long time entertained. It will be remembered that the unfortunate Giordano Bruno, in his work published in 1591, maintained that each star is a sun about which planets revolve, but the sequel of this tale is more pleasant to think of than the fate of Bruno, for we find that the Wezeer Fáris finally "embraced al-Islam, he and they who were with him."

GEORGE J. WALKER.

ON OLD ACHROMATICS OF SHORT FOCAL LENGTHS.

Sir,—In an anonymous little work called *A Companion to the Telescope*, published in 1811, mention is made of achromatics constructed by the Dollands with triple object-glasses, having an aperture of 3¾ inches and a focal length of only 46 inches. Thus the proportion of focal length to aperture was only 12·27 to 1. In modern instruments, by our very best makers, for instance by Mr. Wray, the proportion of focal length to aperture, in instruments of this size, is 14·4 to 1.

Yet those achromatics by the Dollands are stated to have performed admirably; for example, with a power of 180, ϵ Boötis was seen double, the orange star accompanying the green one being shown one diameter of the small star separate from the large one. γ Leonis too could be easily made out to be double with a power of 180, while with 350 the separation amounted to half a diameter of the larger star.

In the work referred to, no precise date is given for the construction of the achromatics in question, but, from a passage in the book, "a pot of uncommonly fine pure flint glass which the Dollands met with about the the year 1760 or 1765" appears to have been employed for the purpose. The achromatic specially spoken of here was, at any rate, constructed prior to 1785, as it had belonged to a gentleman who, in the *Philosophical Transactions* of that year, is spoken of as, "the late Mr. Aubert."

Not only, then, were achromatics of very short focal length compared with their aperture, made about 100 years ago, but their excellence, as shown by the powers they bore, appears to have equalled, if not exceeded, that of modern achromatics of a similar size. Thus, while an achromatic by Merz, of 4-ft. 9-in. focal length and 3·81-in. aperture, English measure, is provided with powers not exceeding 243, the old triple object-glass, of 4-ft. 6-in. focus and 3¾-in. aperture, bore a power of 350.

From what the writer of *A Companion to the Telescope* says, it seems the Dollands never made any *triple* object-glasses larger than those spoken of, and as, in speaking of one of them, Mr. Peter Dolland is reported by the author of the above work to have said to him, "Yes, that object-glass is one of the things which will make me immortal," it may be fairly inferred that they were not parted with to any persons but those who were likely to appreciate them duly. It is, therefore, at least possible that some of these instruments may have outlived the vicissitudes of 100 years, and have passed into the possession of owners who would permit them to be compared with similar achromatics of modern date.

Whether any of these venerable instruments still survive is certainly doubtful, yet perhaps the *old* "3-ft. 6-in. telescope, by Dolland, with 3⅝-in. object-glass," which was sold yesterday by auction in Pall Mall, is a member of that ancient and highly respectable family. The proportion of its focal length compared with its aperture, namely only 11·58 to 1, is, at any rate, much less than the *late* Mr. Dolland was in the habit of giving to the instruments constructed by him.

I am, Sir, your obedient servant,

June 19, 1875. SENEX.

INTERNATIONAL METEOROLOGICAL SCALES.

In this month's *Register*, Prof. Piazzi Smyth again reverts to his idea of the earth's axis having been defined by the Archaic Egyptians as a round number of inches. If your readers will please turn to *Trans. Soc. Biblical Archæology*, vol. i. p. 334–8, they will find my reasons for supposing it equally tenable, and far more probable that (like the French meter-founders, Delambre et Soc) a tract of land intervening between the dip of a star to the extent of an aliquot part of π in altitude was the *measured* aliquot round number of the earth's circumference. In this memoir I showed that Mechain's π depending on arc cot 70— arc cot 99 or arc cot 239 is $0^\circ\ 14'\ 22''\cdot84$ or $862''\cdot84 = 57$s.,523, $862''\cdot83 \cos 30^\circ = 747'',242 = \cdot003622728$ or $\frac{119}{120}$ of radius; for the earth 500500000 inch, $\frac{1}{100}$ of this $= 9142\frac{1}{16}$ inch, the base of the Gt. Pyr. to $\frac{1}{16}$ inch. For $\cdot0036524224$ the $\frac{119}{120}$, diff. is $0''1531$ in $747''$ and $0''1786$ in $863''$.

Sir G. Airy makes earth's diam. vary from 502,169112 to 500,491400 inch. In 1862 I found $\pi = \frac{21}{20}$ $(3\times10^6=8007$ mins.) to eight decimals, or rad. $= \frac{20}{63} \times 5013380713\frac{1}{8}$ really 5013387074. Hence base of Gt. Pyr. is $\frac{1}{100}$ of (arc less 45°) which cot. is $\frac{120}{119}$, which arc is double of arc tan. $= \frac{5}{12}$ and quadruple of arc tan. $= \frac{1}{5}$.

I agree with Prof. C. P. S. in the superior advantages of a fundamental temperature that ripens cereals for man's food. In the archaic times, when Europe was one overgrown forest, temp. of Egypt must have resembled Florida when the Spaniards discovered it, ere the axe and plough had opened the soil of both continents. (Cf. Gibbon's "Roman Immaturity of vines on the Danube under the Antonines.")

A few years ago I found our standard London seconds' pendulum of 1825 (62° F. and 30 in. Bar.) gives 883 pendulum lengths equal 960 yards to *one eighteen millionth part*, and from the Sabine-Foster formula, the square of vibration in a mean solar day is 7441625711 + 38286335 sin. sq. lat. I deduced—

Lat. 0°	Pend. $=$ 39·2626896	or	880,2248 in 960 yards.
30°	39·2122539		881,3571
45°	39·1651996		882,4808
60°	39·1117704		883,6214
90°	39·0617213		884,7534

The Pyramid lat. gives $881\cdot3\frac{4}{7}$ or $\frac{12339}{14}$.

As our cubic inch of distilled water weighs 252,458 grains troy, this equals

$$\frac{1010}{4}\left(1-\frac{1}{6000}\right)+\frac{1}{12000}\text{ gr.}$$

and our gallon should measure 277,274 cub. inches, this equals

$$\frac{1100}{4}\left(1\cdot008\ \frac{8}{30}\right)+\frac{1}{1500}\text{ inch.}$$

Also a grain of pure gold is worth $2\frac{1}{8}$ of a penny.

Though it were wonderful if the Gt. Pyr. builders were as accurate calculators as those for the last three centuries, I fancy they were more

likely to experiment in *the same groove* as the moderns, and not always apply *their* π to a fundamental *axial* round number, which they were humanly denied from grasping from pole to pole.

Dr. Löwenherz of the Berlin German Standard-regulating Commission, has presented through me to the Royal and Royal Astronomical Societies copies of his Memoir on the diminution of modern standards of weight. The English pound has not deteriorated in fifteen years, though others (*e.g.*, Denmark's kilogramme) exhibit a secular variation.

23, Upper Barnsbury Street, N.: S. M. DRACH.
August 5, 1875.

P.S.—I have lately heard that the Gt. Pyr. even indicates the new millennium, anno 1881 CÆ.!! *Ergo*, our tourist *Cooks* have not much time to *Gaze*, says above "Contractor of Greek π's."

* Or $\frac{21}{20} + \frac{1200-2}{10^{12}}$ $(3 \cdot 10^{6} - 8007)$ to 16 decimals.

Addendum.—Also com. log. sin. $\left(\frac{\pi}{7} + \frac{1}{11} \text{ sec.}\right)$ is $\frac{631}{990}$ and com. log. cotang. $\frac{\pi}{7}$ is $\left(\frac{119}{375} \text{ or } \frac{7 \cdot 17}{15 \cdot 25}\right) \left(1 + \frac{1}{10^{5}}\right)$ nearly.

This second fraction is representable by describing the concentric semicircles with radii 12 and 20, and at the distance 5 from the common centre, erecting an ordinate, which is cut by the two circumferences in the ratio of $\sqrt{7 \times 17}$ to $\sqrt{15 \times 25}$.

In *Phil. Mag.* for 1863, the late Mr. Willich gave $\sqrt{\pi} = \frac{296}{167}$ nearly, a ratio of 14 sq. + 10 sq. to 14 sq. — 25 — 4, of easy geometric construction; error is *a* $7 - 10^{7}$ part. S. M. D.

August 10, 1875.

VARIOUS MATTERS.

Sir,—The letter which you were good enough to insert for me in last month's *Register*, has had the effect of drawing forth a large number of suggestions, the majority of them good and useful, but so many letters have been written to me that, at the risk of being thought wanting in courtesy, I am forced to take this opportunity of stating that it is impossible for me to give a separate acknowledgment to each, much less to enter into correspondence as to points involved.

I have, however, received from India one letter, a portion of which I think it desirable to ask you to print *pro bono publico*.

The writer, Mr. J. E. Gore, throws out suggestions as to the variability of certain stars. His notes are worded as follows:

"ι Andromedæ. Observed $3\frac{1}{2}$ m. by d'Agelet, and 7 m. by Piazzi and Bradley."

"ζ Corvi. 3 m. in Harding's Atlas, now about 5 m."

"32 Vulpeculæ. 4 m. in Proctor's Atlas, and rated 5, $5\frac{1}{2}$ by Laland. Last year I observed it to be about $6\frac{1}{2}$ m."

"Canopus. Several times last winter I noticed this star to be nearly equal to Sirius."

"22 Canis Majoris. Red, usually rated as $3\frac{1}{2}$ m. Last winter it seemed to me not to exceed $4\frac{1}{2}$ m."

I have no information enabling me to deal with Mr. Gore's remarks, and therefore I should be very glad if some of your correspondents could add to the common stock of knowledge.

Eastbourne, Sussex: I am, sir, your obedient servant,
August 9, 1875. G. F. CHAMBERS.

TRANSIT OF IAPETUS.

Sir,—Thinking it may be of some interest to fellow amateur observers, I send you a few notes of my observations of the Transit of Iapetus on the 2nd instant, made with a very excellent 8½-inch reflector, by Calver, power used 245.

Mirror had been arranged some hours previously at 1 a.m., weather cloudy, determined to take it in, in doing so noticed small patches of clear sky, but dense clouds in the vicinity of Saturn, at 1.45 a.m. partially cleared; got several faint glimpses sufficient to focus and find best power. 30 seconds 18 minutes past 2 a.m. clear view for about two minutes. Iapetus apparently in contact with ring, but air very unsteady, edge of ring not well defined, only principal division seen, waited till 3 a.m., but dense clouds prevailed.

Iapetus at the above time was on the north-east outer edge of the ring, about two-thirds from the planet.

Hoping some of your other readers may have been more favoured by the weather.

I remain, yours obediently,
PHILIP HOLLAND.

Brixton, S.W.

THE AUGUST METEORS.

To the Editor of *The Times.*

Sir,—A look-out was kept up for the "Perseides" here from 10 p.m. last night, August 10, to 1.30 a.m. this morning, August 11.

From 90 to 100 meteors were observed. About a dozen were estimated to be equal in brightness to stars of the first magnitude; the rest to stars of from second to fourth magnitude. A very few minute ones were not counted. Most of the larger ones were accompanied by trains; but, on the whole, the display was less striking than those of many previous years, both as regards the brilliancy and number of the meteors.

Two observers were looking out, but the attention of both was generally directed to the same portion of the heavens—viz., to the S.E. hemisphere from about 10 p.m. to about midnight, and to the N.W. hemisphere from midnight to 1.30 a.m. As, owing to the unsettled state of the weather yesterday, there will probably have been many parts of England where no observations were obtainable, it has occurred to me that this short account may be interesting to some of your readers. The weather here was brilliantly clear, excepting a short cloudy period 10.20 to 10.50 p.m.

G. T. RYVES, F.M.S.

Tean Vicarage, Cheadle,
Staffordshire: August 11.

RING OF LIGHT ROUND VENUS.

Sir,—I observe in the *Astronomical Register* for April last that the Windsor observations of the transit of Venus have been the subject of some discussion at the March meeting of the Royal Astronomical Society. The phenomenon of the ring of light as observed by me, was by no means similar to that described by Capt. Noble, as attending the new moon, and popularly known as the old moon in the new moon's arms. Mr. Christie correctly states that what the observers noticed was not a difference of

intensity between Venus and the sky, and therefore the difference of contrast between the two. There was in fact no marked difference of intensity observed between the dark body of the planet and the sky, but the planet's limb was edged by a comparatively well-defined thread of light which at egress was particularly noticed to be much broader along the northern regions. This was a very marked feature of the halo, and may be readily understood from the diagrams sent to the Society. The beautiful grey light of this ring or halo did not generally shade off in intensity towards the sky region beyond, as appears to be assumed by Capt. Noble, but was abruptly terminated. During the progress of the egress the light along the southern limb of the planet was the first to become invisible. My own impression at the time coincides with the opinion expressed by Mr. Bidder, namely, that the halo must be due to the refraction of the sun's light from the planet's atmosphere.

While writing this note to the *Register*, I may mention that Mr. Birmingham's supposed variable star has been under observation here during the past two evenings. By comparison with B.A.C. 2470 = 6·7 mag., I estimated it to be of the 6·3 mag. This estimate is nearly a whole magnitude greater than Mr. Birmingham's for February 14th. As the star cannot now be seen from northern observatories this observation may be of interest to its discoverer.

Private Observatory, Windsor, JOHN TEBBUTT.
N. S. Wales: June 10, 1875.

MR. BIRMINGHAM'S SUSPECTED NEW STAR.

Sir,—On the occasion of a visit to the Sydney Observatory, since I sent you my letter of the 10th instant, I consulted the catalogues in that institution, with a view to ascertain if Mr. Birmingham's suspected new star had been previously observed. In Lalande's Catalogue for 1800, published in 1847 by the British Association, there is a star of the *sixth* magnitude, numbered 14599, whose position brought up to the beginning of 1875·0, is R. A. = 7h. 23m. 27s., N. P. D. = 100° 4'·0. This object is, doubtless, the one observed by Mr. Birmingham, if not, either Lalande's star or Mr. Birmingham's is not now to be found.

I am, sir, your obedient servant,
Private Observatory, Windsor, JOHN TEBBUTT.
N. S. Wales: June 12, 1875.

ECLIPSE OF THE SUN.

An annular eclipse of the Sun will take place on September the 28—29, partially visible at Greenwich.

	G.M.T. h.	m.
Beginning of Eclipse, September 28	23	24·9
Greatest Phase, September 29	0	6·8
End of Eclipse	0	47·4

Angle from N. Pole of	First contact 111° toward the W.	For direct image.
	Last contact 168° toward the W.	
Angle from Vertex of	First contact 106° toward the W.	
	Last contact 179° toward the W.	

Magnitude of the Eclipse (Sun's diameter = 1) 0·119.

DISCOVERY OF A NEW PLANET (147).

(From *Astronomische Nachrichten,* No. 2,048.)

In the night of the 10th to the 11th July I noticed in a constellation of stars with which I was familiar, a faint little star of the 12th magnitude, the distance of which from A. Oe. 2,051 °/1, I estimated, at about 13h. to be + 3s. and + 3′, but I did not succeed in taking an observation, properly speaking. On the following morning I was enabled to establish that it is in truth a planet. As yet I have obtained the following position thereof:—

1875.	Vienna M. T.	R. A. app.	Decl. app.
July 11.	12h. 59m. 23s.	20h. 19m. 22·78s.	— 17° 29′ 53·6″
„ 12.	13h. 55m. 55s.	20h. 18m. 36·06s.	— 17° 31′ 52·8″
„ 13.	12h. 49m. 0s.	20h. 17m. 53·07s.	— 17° 33′ 47·0″

Magnitude 12·0.

The Director of the Observatory, Professor Carl von Littrow, has been so good as to select the name Protogeneia for the planet.

L. SCHULHOF.

Vienna: July 15, 1875.

DISCOVERY OF A NEW PLANET (148)

By M. Prosper Henry, of Paris.

1875, August 7, 12h. 50m. M.T. Paris.

R. A. (148)	... ...	22h. 39m. 3s.
N. P. D.	... ...	101° 11′·5
Hourly motion, — 1·3s. +36″.		Magnitude 10·7.

(From *A. N.* No. 2,050.)

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN SEPTEMBER, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXVII. British Association map, 65° to 70° N. latitude.

Between 35° and 40° W. longitude Arnold (39) (*a*), 5° Moigno (408), 5° Peters (409), 2½° Meton (41) the south part. Adjoining Meton on the east and extending 2½° W. longitude, Barrow (45) the south part. W. C. Bond (465) the north part, extending from 8° W. longitude to 5° E. longitude. Epigenes (169) (*b*) Birmingham (463) the north part. The valley J. J. Cassini (474) the south part (*c*). In 25° to 30° E. longitude Philolaus (172) the south part (*d*). North-east of Herschel II. (412) [see list for July, *ante* p. 175] is Anaximander (174) (*e*).

(*a*) Arnold is figured by Schröter as T LXII. fig. 1, and described in his "Fragments," vol. II. p. 215, § 786.

(*b*) Schröter gives in T LXI., fig. 2, a group of four craters north-east of the valley J. J. Cassini which separates them from Fontenelle. They bear the names Epigenes, Lexell, Anaxagoras, and Philolaus. The position of these craters, as given by Schröter, do not accord with B. and M.'s map. Schröter's Epigenes appears to be the Philolaus of B. and M. In connection with the fact that B. and M. missed entirely the valley J. J. Cassini which Webb recovered and drew in 1865, if we remember rightly, the two figures of Schröter in his T LXI. should be most scrupulously examined by the aid of some of the large telescopes now in existence. It is much to be regretted that the interest in Selenography appears to be subsiding now that we have

improved means for observationally and photographically studying the surface of our satellite.

(*c*) Schröter's drawing of J. J. Cassini will be found in T LXI., fig. 2, and the description in vol. II., pp. 209 to 211, § 779 of his "Fragments."

(*d*) This crater (Philolaus) appears to be the Epigenes of Schröter T LXI., fig. 1., who places his Philolaus further to the east. As remarked under note (*b*) Schröter's figures are not in accordance with B. and M.

(*e*) Anaximander is very ill-figured, both by Schröter and B. and M. Schröter's figure is in T XXVI., and his description in vol. 1, p. 571, § 292 of his "Fragments."

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat.	Angle of position of sun's axis.	
	°	°	°	°	
Sept. 1	315·24	+13·22	+7·22	21·32	0·25
2	328·46	·22	7·23	21·57	·24
3	341·68	.23	7·24	21·81	·24
4	354·91	·22	7·24	22.05	·24
5	8·13	13·22	+7·25	22·29	·23
6	21·35	·22	7·25	22·52	·22
7	34·57	·22	7·25	22·74	·22
8	47·79	·22	7·25	22·96	·21
9	61·01	·22	7·24	23·17	·20
10	74·23	·22	7·24	23·37	·20
11	87·45	·22	7.23	23·57	·19
12	100·67	13·22	+7·22	23.76	·19
13	113·89	·22	7·21	23·95	·18
14	127·11	·21	7·19	24·13	·18
15	140·32	·22	7·18	24·31	·16
16	153·54	·22	7·16	24·47	·16
17	166·76	·21	7·14	24·63	·16
18	179·97	·22	7·11	24·79	·15
19	193·19	13·21	+7·09	24.94	·14
20	206·40	·22	7·06	25·08	·14
21	219·62	·21	7·03	25·22	·13
22	232·83	·22	7·00	25·35	12
23	246·05	·21	6·97	25·47	·12
24	259·26	·21	6·93	25·59	.11
25	272·47	·21	6·89	25·70	.10
26	285·68	13·22	+6·85	25·80	·09
27	298·90	·21	6·81	25·89	·09
28	312·11	·21	6·77	25·98	·09
29	325·32	·21	6·72	26·07	·07
30	338·53		6·68	26·14	

A.M.

ASTRONOMICAL OCCURRENCES FOR SEPTEMBER, 1875.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m. Saturn
Wed	1		Sidereal Time at Mean Noon, 10h. 40m. 58·26s.			10 54·6
Thur	2		Sun's Meridian Passage 0m. 21·78s. before Mean Noon	2nd Sh. I. 2nd Tr. E.	7 21 7 58	10 50·6
Fri	3	17	Conjunction of Moon and Jupiter, 3° 12′ N.			10 46·2
Sat	4					10 42·0
Sun	5					10 37·8
Mon	6	8 2	Occultation of B.A.C. 5314 (6)			10 33·6
Tues	7	9 37	☽ Moon's First Quarter			10 29·4
Wed	8					10 25·2
Thur	9	0	Conjunction of Moon and Mars 1° 33′ N.			10 21·0
Fri	10			3rd Ec. R.	6 31 38	10 16·9
Sat	11	6 57 7 39	Occultation of B.A.C. 7077 (6) Reappearance of ditto	2nd Ec. R.	7 33 53	10 12·7
Sun	12	5 56 6 51 15	Occultation of 33 Capricorni (5½) Reappearance of ditto Conjunction of Moon and Saturn, 2° 41′ N.			10 8·5
Mon	13					10 4·4
Tues	14	13 20 14 7	Occultation of χ Aquarii (5½) Reappearance of ditto			10 0·2
Wed	15	0 41	○ Full Moon Illuminated portion of disc of Venus=1·000 Illuminated portion of disc of Mars=0·856			9 56·0
Thur	16	15 7 16 14	Occultation of B.A.C. 274 (6) Reappearance of ditto			9 51·9

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn.
Fri	17		Sidereal Time at Mean Noon 11h. 44m. 3·13s. Sun's Meridian Passage 5m. 28·99s. before Mean Noon			9 47·7
Sat	18		Saturn's Ring: Major axis=41″·69 Minor axis=9″·97	2nd Oc. D.	6 9	9 43·6
Sun	19	16 27 16 51	Occultation of 27 Tauri (4) Reappearance of ditto			9 39·4
Mon	20	3	Conjunction of Mars and σ Sagittarii (4·6m.) E.			9 35·3
Tues	21	19 0	☾ Moon's Last Quarter			9 31·2
Wed	22	0 19	Conjunction of Mars and σ Sagittarii 0° 8′ S. Superior conjunction of Mercury and Sun			9 27·0
Thur	23	15 5 16 3 15 54 16 30 17	Occultation of ω^1 Cancri (6) Reappearance of ditto Occultation of ω^2 Cancri (6½) Reappearance of ditto Conjunction of Mercury and α Virginis (5·9m.) W.			9 22·9
Fri	24					9 18·8
Sat	25					9 14·7
Sun	26					9 10·6
Mon	27					9 6·5
Tues	28					9 2·4
Wed	29	0 55 6	● New Moon Eclipse of the Sun Conjunction of Moon and Mercury, 1° 24′ N.			8 58·3
Thur	30	2	Conjunction of Mars and ψ Sagittarii, 0° 8′ N.	1st Oc. D.	6 29	8 54·2
OCT. Fri	1	5 11	Conjunction of Moon and Mercury, 0° 13′ S. Conjunction of Moon and Jupiter, 3° 38′ N. Conjunction of Mars and ψ Sagittarii (3·6m.) W.	1st Tr. E.	6 4	8 50·1

THE PLANETS FOR SEPTEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury...	1st	11 17 57	N. 5 49¾	4″·8	0 36″·9
	9th	12 6 37	S. 0 20	5″·0	0 53″·19
	17th	12 50 39	S. 6 8	5″·4	1 6″·4
	25th	13 31 2	S. 11 19½	5″·7	1 15″·2
Venus ...	1st	10 15 21	N. 11 19	9″·8	23 40″·5
	9th	11 2 48	N. 7 38½	9″·6	23 46″·4
	17th	11 39 37	N. 3 44½	9″·6	23 51″·7
	25th	12 11 34	N. 0 13	9″·6	23 56″·6
Mars ...	1st	18 1 42	S. 27 23	17″·2	7 19″·5
	9th	18 18 4	S. 27 4	16″·0	7 4″·4
	17th	18 36 10	S. 26 38	14″·9	6 51″·0
	25th	18 55 38	S. 26 3	14″·1	6 39″·9
Saturn ...	1st	21 37 20	S. 15 41	16″·8	10 54″·6
	9th	11 35 14	S. 15 51½	16″·8	10 21″·0
	17th	21 33 22	S. 16 0½	16″·6	9 47″·7
	25th	21 31 47	S. 16 8	16″·6	9 14″·7
Neptune ...	18th	2 4 3	N. 10 40½	...	14 13″·7

Mercury is too near the sun to be well observed.

Venus is badly situated for observation, rising about half-an-hour before the sun at the beginning of the month, the interval decreasing.

Mars may be seen for about four hours after sunset at the beginning of the month, the interval slightly increasing. He is of too low a declination to be well observed.

Saturn may be observed till three hours after midnight at the beginning of the month, the interval decreasing.

EPHEMERIS OF THE SATELLITES OF SATURN.

The rectangular co-ordinates of the three inner satellites and the apparent distances of Titan and Iapetus, are expressed in semi-diameters of the planet's equator.

$+x$ East of minor axis of ring. $+y$ North of major axis of ring.
$-x$ West „ „ „ $-y$ South „ „ „

At 20h. Greenwich Sidereal Time.

1875.	Tethys.		Dione.		Rhea.		Titan.		Iapetus.	
Sept.	x	y	x	y	x	y	pos.	dist.	pos.	dist.
1	−4·4	−0·5	−5·6	−0·7	+8·7	+0·4	224·0	6·0	90·2	58·6
2	+4·8	+0·3	+1·3	+1·5	+3·5	−1·9	256·1	11·8	90·4	57·6
3	−5·0	+0·1	+3·9	−1·2	−7·5	−1·1	266·9	17·0	90·6	56·3
4	+5·0	−0·1	−6·4	+0·1	−6·2	+1·5	273·3	20·0	90·8	54·5
5	−4·9	+0·3	+4·5	+1·1	+5·2	+1·7	278·8	19·9	91·0	52·4
6	+4·6	−0·5	+0·4	−1·5	+8·1	−0·9	285·3	16·8	91·3	50·0
7	−4·2	+0·7	−5·1	+0·9	−2·3	−2·0	296·9	11·3	91·5	47·3
8	+3·6	−0·8	+6·3	+0·3	−8·9	+0·2	335·6	5·4	91·8	44·2
9	−2·9	+1·0	−3·2	−1·3	−0·9	+2·1	56·7	7·2	92·2	40·9
10	+2·1	−1·1	−2·0	+1·4	+8.6	+0·6	80·2	13·4	92·6	37·3
11	−1·3	+1·1	+5·9	−0·6	+4·1	−1·9	89·1	18·4	93·1	33·5

12 +0·4	−1·2	−5·7	−0·7	−7·1	−1·3	94·9	20·9	93·8	29·5
13 +0·5	+1·2	+1·7	+1·5	−6·6	+1·4	100·1	20·4	94·7	25·4
14 −1·3	−1·1	+3·5	−1·3	+4·7	+1·8	106·4	17·3	95·9	21·0
15 +2·2	+1·1	−6·3	+0·2	+8·3	−0·8	117·2	12·0	97·5	16·6
16 −2·9	−1·0	+4·8	+1·0	−1·6	−2·1	148·6	6.2	100·9	12·1
17 +3·6	+0·8	0·0	−1·5	−8·9	0·0	226·3	6·4	108·	7·6
18 −4·2	−0·7	−4·8	+1·0	−1·6	+2·1	256·4	12·2	133·	3·4
19 +4·6	+0·5	+6·3	+0·2	+8·3	+0·8	267·1	17·3	233·	3·2
20 −4·9	−0·3	−3·5	−1·3	+4·6	−1·8	273·5	20·0	251·	7·3
21 +5·0	+0·1	−1·7	+1·5	−6·7	−1·4	279·2	19·9	258·5	11·8
22 −5·0	+0·1	+5·7	−0·7	−7·1	+1·3	286·0	16·6	261·9	16·3
23 +4·8	−0·4	−5·9	−0·6	+4·1	+1·9	298·3	11·0	263·8	20·7
24 −4·4	+0·6	+2·0	+1·5	+8·6	−0·6	339·8	5·3	265·0	25·1
25 +3·9	−0·7	+3·2	−1·3	−1·0	−2·1	57·9	7·5	265·9	29·3
26 −3·3	+0·9	−6·3	+0·3	−8·9	−0·2	80·4	13·7	266·6	33·3
27 +2·6	−1·0	+5·0	+1·0	−2·3	+2·1	89·3	18·7	267·1	37·1
28 −1·8	+1·1	−0·4	−1·5	+8·1	+0·9	95·1	20·9	267·5	40·7
29 +1·0	−1·2	−4·6	+1·1	+5·2	−1·8	100·4	20·4	267·9	44·1
30 −0·1	+1·2	+6·4	+0·1	−6·2	−1·6	107·0	17·1	268·2	47·3
Oct.									
1 −0·8	−1·2	−3·8	−1·2	−7·5	+1·2	118·4	11·8	268·5	50·2

Approximate times of the conjunctions of the satellites with the centre of the planet, or of their passing in the direction of the minor axis of the ring.

Gr. Sid. Time.	h.		*y*
Sept. 1	12·1	Tethys	−1·2
	18·9	Encel.	+0·9
2	10·8	Tethys	+1·2
	11·4	Encel.	−0·9
	17·9	Dione	+1·5
	2·9	Rhea	−2·1
	3·8	Encel	+0·9
	9·5	Tethys	−1·2
3	20·3	Encel.	−0·9
	2·8	Dione	−1·5
	8·2	Tethys	+1·2
4	12·8	Encel.	+0·9
	5·3	Encel.	−0·9
	7·0	Tethys	−1·2
	9·2	Rhea	+2·1
5	11·7	Dione	+1·5
	21·8	Encel.	+0·9
	5·7	Tethys	+1·2
6	14·3	Encel.	−0·9
	20·6	Dione	−1·5
	4·4	Tethys	−1·2
	6·7	Encel.	+0·9
7	15·5	Rhea	−2·1
	23·2	Encel.	−0·9
	3·1	Tethys	+1·2
	5·6	Dione	+1·5
8	15·7	Encel.	+0·9
	1·8	Tethys	−1·2
	4·2	Titan	+4·6

Gr. Sid. Time.	h.		*y*
	8·2	Encel.	−0·9
9	14·5	Dione	−1·5
	21·8	Rhea	+2·1
	0·5	Tethys	+1·2
	0·7	Encel.	+0·9
10	17·2	Encel.	−1·0
	23·2	Tethys	−1·2
	23·4	Dione	+1·5
	9·7	Encel.	+1·0
11	21·9	Tethys	+1·2
	2·1	Encel.	−1·0
	4·2	Rhea	−2·1
	8·3	Dione	−1·5
12	18·6	Encel.	+1·0
	20·6	Tethys	−1·2
	11·1	Encel.	−1·0
13	17·2	Dione	+1·5
	19·3	Tethys	+1·2
	3·6	Encel.	+1·0
	10·5	Rhea	+2·1
14	18·1	Tethys	−1·2
	20·1	Encel.	−1·0
	2·2	Dione	−1·5
15	12·6	Encel.	+1·0
	16·8	Tethys	+1·2
	5·0	Encel.	−1·0
	11·1	Dione	+1·5
16	15·5	Tethys	−1·2
	16·8	Rhea	−2·1

Gr. Sid. Time.	h.		y
	21·5	Encel.	+1·0
	7·7	Titan	−4·9
17	14·0	Encel.	−1·0
	14·2	Tethys	+1·2
	20·0	Dione	−1·5
	6·5	Encel.	+1·0
18	12·9	Tethys	−1·2
	? 22	Iapetus in conj. w. following edge of ring	−2·1
	23·0	Encel.	−1·0
	23·1	Rhea	+2·1
	4·9	Dione	+1·5
	? 10	Iapetus	−2·4
	11·6	Tethys	+1·2
19	15·5	Encel.	+1·0
	? 22	Iapetus in conj. w. preceding edge of ring	−2·7
	8·0	Encel.	−1·0
	10·3	Tethys	−1·2
20	13·8	Dione	−1·5
	0·4	Encel.	+1·0
	5·5	Rhea	−2·1
	9·0	Tethys	+1·2
21	16·9	Encel.	−1·0
	22·8	Dione	+1·5
	7·7	Tethys	−1·2
	9·4	Encel.	+1·0
22	1·9	Encel.	−1·0
	6·5	Tethys	+1·2
	7·7	Dione	−1·5
	11·8	Rhea	+2·2

Gr. Sid. Time.	h.		y
23	18·4	Encel.	+1·0
	5·2	Tethys	−1·2
	10·9	Encel.	−1·0
24	16·6	Dione	+1·5
	3·1	Titan	+4·7
	3·4	Encel.	+1·0
	3·9	Tethys	+1·2
25	18·1	Rhea	−2·2
	19·8	Encel.	−1·0
	1·5	Dione	−1·5
	2·6	Tethys	−1·2
	12·3	Encel.	+1·0
26	1·3	Tethys	+1·3
	4·8	Encel.	−1·0
	10·5	Dione	+1·5
27	21·3	Encel.	+1·0
	0·0	Tethys	−1·2
	0·5	Rhea	+2·2
28	13·8	Encel.	−1·0
	19·4	Dione	−1·6
	22·7	Tethys	+1·2
	6·3	Encel.	+1·0
29	21·4	Tethys	−1·2
	22·8	Encel.	−1·0
	4·3	Dione	+1·6
	6·8	Rhea	−2·2
30	15·3	Encel.	+1·0
	20·2	Tethys	+1·2
	7·7	Encel.	−1·0
Oct. 1	13·2	Dione	−1·6
	13·8	Tethys	−1·2
	0·2	Encel.	+1·0

A. MARTH.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec., 1874.
Browning, J.

To May, 1875.
Aldam, W.

To June, 1875.
Compton, A. J.
Howlett, Rev. F.
Jefferies, J.

To July, 1875.
Putland, C.
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Hutchings, Rev. R. S.

To Sept., 1875
Elliott, R.
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Jackson-Gwilt, Mrs. H.

To Nov., 1875.
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To Dec., 1875.
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Metcalfe, Rev. W. R.
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Thompson, Professor.
Wright, Rev. W. H.

To Jan., 1876.
Daw, E.

To June, 1876.
Tupman, Captain.

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The Astronomical Register.

No. 154. OCTOBER. 1875.

THE BRITISH ASSOCIATION.

The meeting of the British Association for 1875 has come and gone, and its best for the further stimulation of science has been doubtlessly effected. Assembling in one of the most interesting and picturesque quarters of England; meeting in a city long one of the most important centres of English commerce, ere the present great centres of industry and population had emerged from the condition of rural hamlets, the success of the meeting in a numerical sense was ensured. Nor can the results achieved this year, in the form of a pleasant excursion and an agreeable relaxation be questioned, for in this respect nothing more could have been desired, and the harmony of the whole was this year at least unimpaired by any subject for regret.

But to those to whom the history for forty years of the Association founded at York is not unfamiliar, and who can recall the brilliant results arising out of the earlier meetings, together with the substantial proofs of its endeavours to promote the progress of science, this last meeting will have given little cause for congratulation. The earlier volumes of the reports contain many valuable records of original work, and the meetings of the British Association proved invaluable in promoting researches on those more recondite or complex subjects, which are almost beyond the ability of any one worker to achieve.

At this period of its existence, also, the British Association might in a sense be regarded as cosmopolitan, and as far as Great Britain was concerned, all the principal members of the scientific world might be relied upon as being present. Nor would many absentees be found in the perhaps still more important group of scientific workers, who less known to the general scientific world from their being of younger standing, and occupying less influential positions and offices, but to whom most of the scientific work achieved is due, and from whom must proceed the leaders of science in the immediate future. And too much importance cannot be attached to the co-operation of the members of this class of scientific labourers, who though rising steadily into reputation, and from whom must be looked for, in the main, the solution of the still unsettled problems of science, have not as yet from their position acquired the fame deservedly attached to their seniors for their past achievements. Much indeed of the great fame of the British Association arose from most of its founders and earliest supporters belonging to this category of scientific men, and both the Association and the great workers it comprised rose to eminence together.

Yet of late signs of deterioration have become manifest, and year by year have become more distinct, until they bid fair to reach an importance that may slowly but surely imperil the success of the great Association for the Advancement of Science, founded in York now over forty years back. Experience has shown in many instances that such signs cannot be neglected with safety, for though the danger they threaten may be far off, and all signs of its existence apparently trivial, yet when an association has proceeded so far in its downward course that its perils become prominent, it is rarely that the final crash can be averted. Those, therefore, who would regret to see the success of the British Association endangered, and they are as yet numerous, find little cause for congratulation in any mere temporary increase in the sale of tickets, whilst no attempt is made year after year to increase the permanent advantages offered by the meetings.

Those familiar with the inner life of the various great scientific societies devoted to special branches, apart from merely the official, cannot but have recognised that a growing antagonism has arisen between them and the British Association, which however partial and confined as yet, bids fair to sow the seeds of more lasting discord, and the very slowness of growth of this antagonism, at present hardly palpable, renders it only the more to be regretted, for it offers little chance of its eradication. Fortunately, as long as the present pillars of science hold their offices of emolument

and authority there is slight reason for fearing that this feeling will find vent except in isolated explosions, though very unfortunately it has been found impossible of late to entirely repress these. And any want of harmony between the great special societies and the British Association for the Advancement of Science would be more to be regretted as it could only end in seriously endangering the latter popular gathering.

The papers now read before the meetings of the British Association are rarely of the high class of those that not long back used to constitute the greater number, and many in fact scarcely deserve the name of "scientific communications." The committees of the various sections are popularly supposed to allow only such papers to be read as come truly within the scope of the British Association as a "scientific society," and it is generally trusted that at least the secretaries use some discrimination beyond merely excluding offensive contributions. Yet this year even more than in the previous years, papers were admitted that under no conceivable stand-point could be termed scientific. This is to be regretted, and steps should certainly be taken by the various committees to so raise the standard of scientific quality as to exclude all but what might in any way be reasonably termed scientific communications. The critiques of the literary journals on the meeting of this year ought to sufficiently enlighten the officials as to opinion pretty prevalent in many scientific circles.

Unfortunately the quality of the papers making some pretence to scientific merit is far from what is desirable, and they consist in part of short notes, technical and special, which, however reasonably well suited for the special societies, are in no way of the general interest or importance that all such communications for the British Association should be. But too many of the papers are not original in the real sense of the term, and mere fragments of more elaborate and finished papers that are to be communicated to some special society, or else *réchauffés*, these last being always particularly objectionable in such gatherings as the British Association. Of late, however, this has become more noticeable, and it is rare that a paper of value or general interest is communicated to the British Association, these now going almost without exception to the Royal Society or to one of those societies devoted to the special branch of science including the subject of the paper.

Now, this deterioration in the quality of the papers communicated to the annual meeting of the British Association is a point that should receive the immediate attention of the officials who sway the destinies of the Association, and endeavours should also

be made to obtain a more suitable class of communications; papers of interest, or distinct importance, raising or discussing questions of moment, such as would either from their value merit general attention, or else from their nature admit of and deserve serious discussion. That such papers are yearly published few will question who are acquainted with the work of the great societies devoted to special branches of science. Of the many points which might be mentioned where reform would be advisable, and tend much to raise the quality of the communications read, the method adopted in the publication and character of the report stands prominent, for as long as only a short abstract of the papers read is to be published some year after the meeting, no scientific worker will care to bury a paper of any interest in such a tomb. And it is not too much to say that ninety-nine out of one hundred copies of the report remain with their pages sensibly uncut. This might surely be rectified, and authors might generally understand that any paper of interest and importance, if of reasonable length would appear in full, whilst with any reasonable diligence the yearly report might appear before the expiration of the year, or even within three months.

Another point where of late the British Association has failed to attain the success of its former results, has been in the constitution and work of the different committees appointed from time to time to effect definite results. Some of the committees have in fact been only with difficulty rescued from ending in a complete *fiasco*, whilst the greatest success of one was at one period likely to be the seriously embroiling the British Association with one of the most distinguished and influential special societies. And if others have skilfully avoided any such *contretemps*, the scientific ends furthered by their labours have been miserably small. Even several of the most successful have simply accumulated an immense mass of figures or data, without in any way classifying, digesting, or even rendering them presentable, so that as far as any useful scientific results are concerned they were perfectly valueless.

To avoid this waste of both time and opportunity, greater care ought to be exercised in both selecting the committee and choosing the results to be attained. To appoint a committee consisting of a string of brilliant names, and then allow the entire work to fall to one, whilst the others make scarcely a pretence of aiding, is neither the manner to secure results of value, nor the manner in which the past brilliant successes in this direction were attained by the British Association. At present members are often placed on a committee who it is known will scarcely take the slightest part in the same, and are, as likely as not, not wanted to do so, their names being borrowed simply to make a show.

Reform in this matter is a point which ought to be secured, and all committees appointed, not only carefully selected so as to obtain a real working body, but to secure results of value, greater control exercised by the sectional committees over their work; and they should not, as at present, be allowed to degenerate into irresponsible impalpable nonentities.

Before concluding, attention should be directed to the position of the British Association in connection with a subject that all who have its interest at heart can but agree demands earnest attention, and that is the persistent attempts that have been made to stigmatize it as a nest of cliques and schemes. Those who knew the British Association in its past, cannot credit that such assertions could be for one moment put forward, far less credited, by any scientific man of position, and any rumour that might have been set in circulation crediting this great assembly of scientific workers with being made the means for promoting personal schemes of any kind whatever, would have been indignantly repudiated on all hands. Nor is it to be supposed that even now anything of the kind would be tolerated on the part of the many eminent scientific men connected with the British Association. But such attempts to weaken its authority cannot be passed over in silence, for no one with a real desire to promote the welfare of science would overlook a matter of this nature. For once let the British Association obtain the reputation of being a nest of cliques and schemers, and, whether deserved or not, an association which has done much for science would be irreparably damaged, and its present great authority and influence irretrievably weakened.

It is, therefore, a serious matter in the eyes of many independent members of the British Association, that, justly or unjustly, it is being stigmatized as a nest of cliquism, banded together to support one another, and employed as a means of prosecuting certain schemes. And unfortunately, though it may be pointed out most forcibly how impossible that the many eminent members of the scientific world would permit this being carried on with their authority, this opinion, which must be baseless, is slowly gaining weight and credence it is unworthy of.

Much as it is to be regretted, few scientific men with the slightest general acquaintance with scientific circles do not know full well that they include several men of admitted position and reputation who hold this opinion. And, as it chances, events this year have so tended as to give some apparent ground for this idea. The importance of the results of these murmurs was unfortunately distinctly traceable last year, and even more this year in the absence of many, too many, of those who either have won, or bid

fair to win, a great reputation in their more special branches of science, whilst others though attending made no pretence even of taking part in the proceedings, or in guiding the progress of the Association, and these belong to the class of members of the highest value, without whose zealous co-operation the British Association can never reach that pinnacle it once bid fair to occupy.

The purposes for which the British Association was founded, as stated in the commencement of its rules—"To give a stronger impulse and a more systematic direction to scientific inquiry, to promote the intercourse of those who cultivate science in different parts of the British Empire with one another, and with foreign philosophers; to obtain a more general attention to the objects of science, and a removal of any disadvantages of a public kind which impede its progress"—are still as necessary as ever, and there exist no reasons why the results of the labours of the British Association should not possess the high value once attaching to them. The independent members, therefore, should seriously consider whether steps might not be taken on their part to restore much of the authority now lost amongst scientific men of the British Association, and see that means were taken, by raising the standard of the papers read, and exercising a fuller and stricter control over the *materiel* and work of the committee, to place its labours on a sounder footing.

This year, as last year, exhibits no improvements in these matters. So far, in fact, from any improvement having taken place, the objectionable features are more marked than ever, and therefore those who consider the best interests of the British Association to be at stake, find little source for congratulation in the past meeting.

Steadily the British Association for the Advancement of Science is falling lower and lower as a scientific assemblage, and though it fully maintains its ancient renown as a pleasant excursion and an agreeable relaxation from scientific labours, if this last is now to be held the main purpose of its existence, the sooner it amalgamates with the "*Bas-Bleu*" of the Social Science, and degenerates into a mixture of pic-nics and farces the better for science. But this will surely never be, and under better management it is to be trusted its former reputation will be regained, and it will again hold the high position befitting it as the British Association for the Advancement of Science.

ANCIENT ASTRONOMY AND ECLIPSES OF THE CHINESE.

By S. J. Johnson.

In speaking of the earliest observers of the starry heavens, we usually carry back our thoughts to the days of the Chaldeans and Egyptians. The Chinese, also, seem to have attended to astronomical pursuits in some fashion, from a remote antiquity. M. Arago tells us that more than 20 centuries before the Christian era they employed the year of 365d.·25, that is to say, three successive years of 365 days, and a fourth year of 366 days, as in the Julian Calendar. In early times they measured the year by the return of the sun to the winter solstice, the epoch of which they determined by the length of the shadows cast by gnomons. They allowed the year of 365·25d. to run on until the observations with the gnomon indicated that this deviated sensibly from the passages of the true sun through the solstice. They then effected a reformation analogous to the Gregorian alteration in 1582. Dr. Vince also enters into the early astronomy of the Chinese and Indians. We may pass over what he says about legendary ages, as for instance about Yu-chi observing the pole-star and constructing a sphere, about 2627 B.C., or about the Emperor Chueni composing an ephemeris of the planets in 2513 B.C. Coming to more historical times, Vince remarks that "from the year 480 B.C. to the year 206 B.C., astronomy was almost entirely neglected, the empire was divided into small states, and the society of mathematicians was destroyed. Tsin-Chi-Hoang united again the states, and formed one great empire, and in the year 246 B.C., he collected the historical and mathematical works and burned them. But the study of astronomy revived again under Lieon-Pang, in the year 206 B.C. About 300 years before our era, the Chinese made their year 365¼ days. The period of the moon they knew within 20″ or 30″, but they had a very inaccurate knowledge of its revolution in respect of the nodes, and in respect to that of the apogee they seem to have been altogether unacquainted. At the same time they had a method of calculating eclipses. In the year 104 B.C. Sse-Ma-Tsien and Lohia-Hong formed precepts for calculating the motions of the planets and eclipses; at that time they made the obliquity of the ecliptic 23° 29′. Towards the year 90 A.D. the Emperor Tchang-Ti corrected the calendar, having found that the solstice had gone back 5°. About the year 164 A.D., Tchang-Heng made a catalogue of 2,500 stars which is now lost. In the year 206 Lieon-Hong and Tsay-Yong discovered that the moon's motion

was not uniform, but subject to an inequality, the maximum of which was 4° 55′ 41″, and they made the obliquity of its orbit to be about 6°. They knew the solar year to be a little less than 365¼ days, and they determined the revolution of the moon in respect of its apogee to be 27d. 13h. 16′ 50″. In the year 284, Kiang-Ki determined the true place of the sun by means of eclipses of the moon. About the year 460 Tsou-Chong determined the motions of the stars to be 1° in 46 years. Lieon-Hiad-Tsun and Lieon-Tcho about the year 584 applied the first equation of the inequality of the sun. Y-hang, who lived about the year 720, made the sun's inequality 2° 21′ 30″. He also determined the time of Jupiter's revolution, and made the latitude of Sirius 39° 25′ 30″. In the year 822 Su-Gang explained the parallax of longitude, and showed its uses in calculating solar eclipses. Towards the year 1280 the Chinese erected a gnomon of 40 feet, from the observations of which by Co-Cheou-King they found the obliquity of the ecliptic to be 23° 33′ 40″, and if this be corrected by refraction it becomes 23° 34′ 36″. It is said that this astronomer was the first among them who understood anything of spherical trigonometry. He also invented a method of calculating solar eclipses.

The well-known work of the Twan Lin includes information of various celestial phenomena. In the *Monthly Notices* of the Royal Astronomical Society for April, 1873, is a paper by Mr. Williams giving some account of sun-spots, taken from the above, and extending over a period of 904 years. If more records of solar spots could be obtained, it is not impossible we might find some ancient transit of Venus had been seen, no doubt without the black dot being recognised as the planet. Venus is said to have been very distinctly seen on the sun, with the naked eye, at the transit last December.

Some years ago two lists of solar eclipses, said to have been observed in China, were presented to the R. A. S. by Mr. Williams, one dating from B.C. 720 to B.C. 495, the second reaching from B.C. 481 to B.C. 1. (Mr. Williams informed me shortly before his death, that he hoped to present further lists to the Society soon.) The writer states, "I have to remark, that I have merely given the data for these eclipses, as they occur in the Chun-Tsew, leaving it to those who are accustomed to this kind of work, and who may feel an interest in it, to ascertain the correctness of the recorded observations, and thus to test the general accuracy of early Chinese history. Not being aware whether any investigation of these eclipses has been entered into, I have made approximate calculations respecting some of them. The same method gives very satisfactory results for the Nineveh eclipse B.C. 763,

and various other ancient ones. It is suggested the observations of these Chinese eclipses might be made in the state of Loo, between the great rivers Yang-tze-keang and Hwang Ho, between 32°—34° north latitude, and 115°—120° east longitude. I therefore computed for a point in longitude 118° and latitude 33°, being about the centre of the supposed district. Seven eclipses on Mr. Williams' list are termed total, those of B.C. 709, 601, 443, 382, 301, 188, 181. None of them turn out total at this spot, though some are of considerable magnitude, but one circumstance deserves notice, that in every instance the greatest phase seems to have occurred north of this place.

Mr. Williams speaks of the eclipses of 552 and 549, Nos. 22 and 25 of the first list, having happened the month after the eclipse immediately preceding them. The explanation is easily given. The eclipses of 552, August 20, and 549, June 19, actually took place, the two succeeding ones did not occur. It seems both eclipses of 204 B.C., and both of 177 B.C. should be erased. One would wish the Chinese accounts had particularized more instead of giving a bare notice of the event.

Eclipse of 720, July 17. This, an eclipse in the autumn of this year, in the seventh moon, seems to have attained a magnitude of two-thirds on the sun's upper limb, about 2h. 55m. p.m., in longitude 118° east, and latitude 33° north.

Eclipse of 601, September 20. Given as the eclipse of Thales by Prideaux. A little calculation would show that this was quite inadmissible. Here, in China, it would seem to be a total phenomenon a few minutes before 3h., and at the place referred to nine-tenths would be obscured.

Eclipse of 443, October 13. "Total, stars seen," according to the Tung Keen Kang Muh, but according to my reckoning, of only half the sun's diameter. On the morning of October 24, 444 B.C., there seems to have been a much larger eclipse.

Eclipse of 382, July 3. While the tables do not indicate totality about this spot, they show a very large eclipse about 7 in the morning, also described as "Total, stars seen."

Eclipse of 301, August 6. An eclipse on the sun's north limb on the afternoon of this day, but the magnitude proves small.

Eclipse of 188, July 17. Mentioned as total in China in the Tung Keen Kang Muh, and referred to also in Tycho Brahé's *Historia Celestis,* as having been seen at Rome, in these words: "Solis eclipsis anno orbis C. 565, C. Livio Salviatore et Marco Valerio Messalo coss. ⊙ inter tertiam et quartam diei horam Romæ defecit. Ex Livio lib. 8 dec. 3."

Nearly total in latitude 33° N., longitude 118° E. Totality, according to the tables employed, passed a little north of this

point, but owing to the small excess of the moon's semi-diameter over that of the sun the duration would be short. At Rome the magnitude would also be very great, and nearly total between 5h. and 6h. in the morning.

Eclipse of 181, March 4. The sun would be a crescent about 2¼h. afternoon, being 11 digits eclipsed. Totality a little to the north.

Upton Helions Rectory,
Crediton: August 21, 1875.

ALLUSIONS TO THE HEAVENLY BODIES IN THE BEDOUIN ROMANCE OF ANTAR.

The principal author of this ancient and celebrated romance was Assmai, who flourished in the courts of the Khalifs Harun and Mamun, and has given in it a picture of the golden age of the Arabians before Mohammed, which was hardly 200 years anterior to the time in which he lived. The original is very voluminous, equal to six folio volumes. One portion only, in an abridged form, has been translated by Terrick Hamilton, Oriental Secretary to the British Embassy at Constantinople (John Murray, 1820, 4 vols.), from which, in default of access to the original, the following allusions have been extracted: "To the Arabs it is their standard work, which excites in them the wildest emotions, read by some, firm in the memory of others, and listened to with avidity by all. * * * This is the work, and not, as is generally supposed, the 'Thousand and One Nights,' which is the source of the stories which fill the tents and cottages in Arabia and Egypt, though materials are often supplied from other works of the same kind." (Preface.) The hero, Antar, was the author of one of the seven poems suspended in the Kaaba. The romance, which was probably put together from traditionary tales, has afforded many illustrations of sacred scripture (see *Journal of Sacred Literature*, January, 1850), and it is also interesting to note how the heavenly bodies, used by the Arabs to foretell changes of the weather, and for astrological purposes, furnished their poets with images, comparisons and figures. Many of these may be of far higher antiquity than Assmai, or the famous warrior and poet whose exploits he narrates. The translator has thought fit to change the Arabic names of the stars for the Greek. It is assumed that he has not made mistakes in so doing, but in one or two instances a conjectural emendation has been hazarded.

SEVEN HEAVENS are mentioned (as in the Koran). "By the raiser of the seven heavens, who knows every secret" (ii. p. 226). "I am Antar, son of Shedad, and my star is raised high above the sublimity of the seven heavens!" (iii. 370.) "My ambition rends the seven ranges of heaven." (iv. 406.)

And *seven earths*: "Ibla shall not be withheld from you, were she even beneath the seventh earth" (ii. 106).

THE SUN AND MOON afford frequent comparisons for female beauty. Antar, describing the maiden Ibla, with whom he was violently in love, says, "She walks away; I should say her face was truly the sun when its lustre dazzles the beholders. She gazes; I should say it was the full moon in the night when Orion girds it with his stars" (i. 39). Again: "The sun as it sets turns towards her, and says, Darkness obscures the land, do thou rise in my absence; and the brilliant moon calls out to her, Come forth, for thy face is like me when I am at the full, and in all my

glory!" (i. 122). Again: "Since the new-born moon beheld her, it snatched up light from her countenance, and became full-orbed, and the shadow of night was astonished: she let her hair flow down and there came on a total darkness" (ii. 199). Of Semeeah he says, "When her tresses hang dishevelled, she is like the rising full moon, veiled in the darkness of night" (i. 60). "Lands, where the brilliancy of the veiled full moons may be seen in the obscurity of their sable ringlets" (i. 279). In praise of king Chosroe: "The sun has invested him with a crown, so that the world need not fear darkness. The stars are his jewels, in which there is a moon brilliant and luminous as at its full" (i. 291). White marks on horses are likened to the moon "Khosrewan was mounted on a long-tailed steed, marked with the new moon on his forehead" (i. 244). Antar says of his horse, "My piebald steed has a white crescent on its forehead, like the dawn of day, and its black is like the sable raven" (iii. 258).

The Planets. "This eternal banishment will never end: it is a separation that exceeds the distance of the planets" (ii. 38). Their women are like fawns, and their children like the glittering planet Venus" (iii. 8). "These shall ever be my deeds with the foe as long as the sun shines, and as long as the morning star glitters at the dawn" (ii. 230). "Is it not known that my power is sublime on high? Is it not among the stars in the vicinity of Jupiter?" (i. 272). "I have attained honour, glory, and fame, by my resolution, so that I am in the vicinity of Jupiter" (iii. 362). "I am the son of Shedad, whose fame is on high, mounting till it approaches the sphere of Jupiter" (iv. 344). To Chosroe: "O full moon of this period; O thou planet Saturn; O thou whose seat is raised above Pisces" (i. 288) "My heart is on high above the planet Saturn" (ii. 334).

Shooting stars are thus alluded to: "They brandished their spears, glittering like the shooting stars" (iv. 34). Harith to king Cais: "Thou art raised up to the brilliant shooting stars by courage, thou hast raised thy station above Pisces" (iv. 136). Antar says, "I have a sword whose brilliancy flashes like lightning, and when my hand wields it, it sparkles like the shooting stars" (iv. 145). Of the fleetness of the horse Dahis, it is said, "To any one that saw him he appeared like an arrow in its most rapid flight, or a star sped with calamities" (iv. 169).

The constellations generally are referred to: "These maidens who resemble the constellations" (i. 277). Of some horsemen it is said, "Their countenances were like the sparkling constellations" (iv. 306). "Should glory itself aim at thy height, exceeding the distance of the stars, it might approach thee" (iv. 385). The diurnal motion of the stars a figure of perpetuity, "Let the heart of thy father, O thou my hope, be this day at ease! Let him sleep by night as long as the stars wander in the skies" (ii. 112).

The two bears: "I am exalted by my sword and spear far above the minutest stars and the two bears" (i. 112). "I am exalted by my scimetar and my spear to the sublimity of the shooting stars and the two bears" (ii. 50). "I am exalted above the sun and moon, and the Great Bear" (i. 323). Selma, rescued by Antar, says, "May thy glories ever increase in sublimity, even to the sign of the Lyra and the two bears" (ii. 237). "My star is above the minutest stars in the constellation of the Great Bear" (iv. 299). It is not unlikely that the original refers to the small star Suha, the more distant companion of ζ Ursæ Majoris (See *Cycle* ii. 300, and *Astronomical Register*, vol. ix., 1871, Appendix on "Arabic Names," &c.).

Arcturus. "My star is high above the brilliant Arcturus" (i. 239). Ambition I have, and its mansion is above Arcturus, and my residence

is exalted to the skies" (iii. 12). "I am raised above Arcturus and the Lyra or the Eagle" (iii. 66). "My star shines far raised on high, above Arcturus, above the sun, above the clouds" (iii. 75).

LYRA Besides the mention in the above passages, there is the following: "How can gratitude be conveyed to the noble hero, when the Pisces and the Lyra fall short of it?" (iv. 383).

EAGLE occurs in one of the above passages.

ARIES. Antar to Chosroe: "O thou whose station is sublime, in thy beneficence above the height of Sirius and Aries!" (i. 311).

PLEIADES. "My ambition is raised above the Pleiades, and the fortune of my star is suspended from heaven" (i. 160). "My ambition soars above the Pleiades, and my fortunate star sparkles with brilliant rays" (i. 237). "We have mounted above the Pleiades in their sublimity" (iii. 177). "In my ambition I will exalt myself to the Pleiades by my never-failing fortune and illustrious deeds" (iii. 178). "My glory is on high, in the towers of the Pleiades" (iv. 406). "I visited him when darkness had spread out its foot: he was like a full moon in the cup of the Pleiades" (iv. 313).

GEMINI. "In the noon-tide sun she dances, and her face is spotted like the full moon of night with the star of the Gemini" (i. 64).

PISCES. Besides the allusions in two of the above passages we have the following: "My ambition soars above Pisces" (i. 85). "In my sublimity I will mount above the Pisces" (i. 185). "O tribe of Abs, be strong in glory, and boast of a slave whose mansion is between the Pisces" (ii. 226). "His mansion is above the two Pisces" (iv. 42). "No other knight possesses my ambition! its seat is above the Pisces" (iv. 87). "I have that ambition, whose seat is above Pisces" (iv. 91). It will be seen that in the portion of the romance in question, this constellation is mentioned oftener than any other. It may, however, be doubted whether these references (some or all) are to the sign Pisces, and not rather to that "enormous asterism of the ancient Arabs called the Lion, without any reference to that of the zodiac." (See *Cycle* ii pp. 296, 316; *Astronomical Register* vol. ix., 1871, Appendix.) The Arabic names are similar, *Simak* is fishes, *Samak* the sign Pisces, and *as-Simakani* (dual of *Simak*) Arcturus and Spica, in the feet of the great Lion. Arcturus, moreover, passing through or near the zenith in Arabian latitudes (like some of the other stars referred to) would be, apparently, a more fit emblem of exaltation than Pisces. Spica, the other *Simak*, forms the xivth Lunar Mansion.

ORION. Once mentioned above, and again: "I will not cease to exalt myself by my deeds, till I reach Orion in my ambitious projects" (i. 68).

SIRIUS. Once alluded to above; and of the tyrant Ghasik it is said, "His countries were Tahl and Zal, and he and his tribe worshipped the great dog-star" (iii. 144). (The tribe of Arcat worshipped the new and full moon, "renouncing Him who spread out the earth and raised up the skies.") (iii. 326.)

Some of the Arabian tribes looked up to a Supreme Being. "Yes, said Rebia, let the God who raised the vaulted heavens, and levelled the expanded earth, witness my grant to you" (i. 43). "Yes, said Antar, by the God that has decorated the heavens, and raised them on high, and has adorned them with stars, were I able, I would make my eye her resting-place" (i. 74). "King Zoheir said to him, By the mover of the heavens, no one shall be my companion to-day but you" (i. 93). "I swear by Him who slays and brings to life, by Him who rules the light and the darkness" (iii. 370).

Astrologers are once mentioned. "You are right, she replied, for the daughters of Arabia value the goods of a merchant, a blacksmith, an

astrologer, and a perfumer" (i. 17). The heavenly bodies are invoked to sympathise with human sorrow. Shedad, Antar's father, mourning for his son's supposed death, says, "Let the heavens weep his loss and death in tears! May its showers be exhausted for ever! Let the beauteous stars fall at his fatal end! Let the air be darkened, and the sun be eclipsed! Let the full moon be veiled also in her station through grief, and may she ever be involved in obscurity!" (i. 319). And Antar, lamenting the death of King Zoheir: "Set is the full moon, though once it was in its zenith; hidden is its light, and all is dark. Eclipsed is the sun, and the morn no more returns in smiles. Fallen are the constellations; they have disappeared; the atmosphere is obscured; the dust of darkness is over it; all the seas are hollow, and are sunk deep; we have lost its dews and its clouds" (iii. 369). GEORGE J. WALKER.

REVIEWS.

Report addressed to the Board of Visitors of the Royal Observatory, Edinburgh, at their Visitation thereof on Tuesday, May 18th, and issued to the Public on May 31st, 1875.

The Astronomer-Royal for Scotland has for Assistants Mr. Wallace and Mr. Thos. Heath (lately appointed), of whom he speaks in high terms. In spite of various unfavourable circumstances, good work is carried on in this observatory: this comprises "the daily time observations and time signals by both ball, gun, and controlled clocks; as well as the lengthy calculations of the meteorological returns from fifty-five observing stations of the Scottish Meteorological Society for the Registrar-General." The catalogue of 4,000 stars is progressing, a large proportion of which will be represented by numerous observations, and these will be grouped so as to exhibit something of the path, or history of the movement of each star from 1830 to 1870; first in theory according to normal computations of procession; and then in fact from the observations themselves, so far as the stars were sufficiently observed for that purpose. The object being to detect proper motion and offer facilities for its future observation, according to the programme drawn up years ago for this observatory continually to follow.

The Spectroscopy of the Zodiacal Light and of the Aurora has been followed up. For the former, Professor Piazzi Smith went to Sicily in 1872, at his own expense. He considers that his conclusions regarding that phenomenon, supported by recent testimonies from other observers, are likely before long to be generally allowed. We observe with regret the still existing hindrances to the efficiency of this important observatory. Money is wanted, for, amongst other things, the re-placing of the present old mural circle by a new transit circle,—the thorough completion of the equatorial,—and a far more powerful spectroscope. We transcribe the following passage from the report.—"The observatory was inspected without any preliminary notice, one afternoon, by the Right Hon. R. Assheton Cross, M.P., Secretary of State for Home Affairs, and thereby the special and particular head of Government under whom this observatory was placed, when it was handed over to 'Her Majesty, her heirs and successors for ever,' by its founders, builders, and first possessors, the late Astronomical Institution of Edinburgh, under the promise made to them that it should always in future be kept up both in a state of scientific efficiency, and as a proper royal and independent observatory. That it has not been fully so maintained as yet (though many small, and in so far good and gratefully acknowledged, things have from time to time been done for it by Government), and that

this now Royal Observatory has consequently, during the last thirty years, been outstripped by almost every chief observatory in every country in the world, whether Regal or Republican, both in new and powerful instruments, extent and pay of personal staff, and funds for general usefulness, is now a matter of public record. But this efficient and conscientious visit of Mr. Secretary Cross last autumn, combined with a letter written by him soon afterwards to Professor Adams of Cambridge, as President of the Royal Astronomical Society of London, and since then communicated to the Secretary of the Board of Visitors, *may* be an earnest of better things to come." Looking to what the present Government has already meritoriously done in the cause of science, we cannot but entertain a strong hope that "better things to come" *will* at no distant period gladden the hearts of Professor Piazzi-Smyth and his assistants, and enable the Edinburgh Observatory to take a place amongst scientific institutions more worthy of the age and the country. To allow the present serious wants and defects to continue unsupplied and unremedied would be poor economy. The present Astronomer-Royal for Scotland was appointed in April, 1845, and has consequently been thirty years in the post.

A Letter addressed without permission to the Astronomer-Royal, explaining a new theory of the solar system, and placing Newton's theories on a physical basis. By G. T. Carruthers, M.A., Chaplain in the East Indies. pp. 64. Longmans.

On a loose sheet accompanying this work, the theory of the solar system is enunciated in seven propositions, and of these the work itself appears to be the development. We transcribe the four first of these propositions. 1. The earth and planets are supported by the atmosphere, or its watery vapour, in the same way as the weight on a safety-valve is supported by the steam in a boiler. 2. The rotation of the earth is caused by the impacts of the atmosphere upon the earth, *i.e.*, by a constant series of blows from the sun of 2116 lbs. upon every square foot. The number of feet passing in a second being, as we know, enormous. 3. The orbital motion of the earth is caused by the rush of cold air (at night) towards the sun, as the air in a room rushes towards a fire-place. Magnus has shown by experiment that such a rush of air upon a revolving cylinder compels the cylinder to move in a lateral direction, similar to that in which the earth moves. 4. The issue of watery vapours of very rare density takes place from the north pole where there is very little rotation. The atoms of vapour gradually accumulate and form condensations of matter at great distances from the north pole, when the force with which they were repelled is expended. Thus the earth has formed the moon, and the sun, and the planets.

The writer's object is to account for the action of gravity. "By assuming the existence of vapour, or even pure motion, we can explain all Kepler's laws" (p. 63). This vapour he believes to be the medium of light (p. 14), and that "Sir Isaac Newton's corpuscular theory of light ought to be maintained" (p. 44). We confess that we have not been able to form a very clear idea of Mr. Carruthers' hypothesis. We heartily wish he may have had more success in advocating the cause of missions in Central India during his visit to England than this brochure is likely to meet with. The pressure of his special engagements may perhaps account for some of its obscurity, but no amount of *limæ labor et mora*, we fear, could give the theory (as far as we understand it) verisimilitude or consistency, although the author hopes that "some one more fit in every way, and with more leisure, will hereafter so treat the subject as to induce its adoption by scientific men" (p. 17).

THE DOMINION OF MATHEMATICS OVER PHYSICAL SCIENCES.

We have put to scientific history the important question, Is it probable that the dominion of mathematics over physical science will be more widely extended than it is at present? Is it probable, not only that we shall improve the mathematical instruments as applied to those sciences which are already recognised as belonging to the legitimate province of mathematical analysis, but also that we shall learn to apply the same instrument to sciences which are now wholly or partially independent of its authority? And to this question I think that scientific history must answer, "Yes, it is probable." It is probable, because physical science is learning more and more every day to see in the phenomena of nature, modifications of that one phenomenon which is peculiarly under the power of mathematics. It is probable, because science already indicates the path by which that advance will be made, because we already possess in molecular dynamics, a method (the creation, I may almost say, of our own age, and still very imperfect), whose proper subject is motion, not in any limited or abstract sense, but as widely as it really exists in nature. And it is probable, because we cannot look back on the history of science for the last fifty years, without becoming conscious how large is the advance which has been already made. . . .

It has been frequently remarked as one of the benefits conferred upon physical science by theory, that it suggests experiment. Nowhere is this principle more strongly exemplified than in the history of, perhaps, the greatest name in optical science—I mean Fresnel. He is an experimentalist, certainly; but he is an experimentalist because he is a theorist. His most valuable experiments had their origin in the desire to test the truth of a theory. The experiment with the two mirrors was devised to test Young's principle of interference. His diffraction experiments were devised at first to test the truth of Young's theory; and when that had been found to be inconsistent with fact, then to test the truth of his own. And, not to multiply instances, the experiments by which he established the existence of circular polarisation, and ascertained the true nature of the light which passes along the axis of a quartz crystal, were suggested by theory. . . .

But to revert to the general subject. If any physicist is inclined to agree with the views of Comte upon this subject, let me propose to him the following test:—Let him strike out of physical optics everything which that science owes to theories of light, and then let him try to write a treatise on the subject, excluding the language and the ideas of theory. Finally, let him compare his work with some treatise in which these aids have not been neglected, and judge himself of their relative value. Theoretic science need not be afraid of the result.

Speaking of the connection between optics and chemistry, Prof. Jellett observes, that the spectroscope has enabled chemistry to overleap a barrier which Comte pronounced to be insurmountable, and which would have excluded from the objects of chemical research anything lying without the limits of our earth. Comte warned us that our knowledge of the planetary worlds was necessarily limited to their geometrical and mechanical properties—to the nature of their movements, and the forces by which they are produced—and that all inquiry into the constituent elements of the planets or their atmospheres was for ever, and by the necessities of the case, interdicted to us. But the spectroscope has told quite another story. . . .

But it is time that I should bring these remarks to a close, and I recur,

in conclusion, to a thought which my subject has already suggested. Let none presume to fix the bounds of science. "Hitherto shalt thou come, but no further." That sentence is not for man. Not by our own powers, not by the powers of our generation, not even by the conceptions of possibility, may we limit the march of scientific discovery. To us, labourers in that great field, it is given to see but a few steps in advance. And when at times a thicker darkness has seemed to gather before them, men have recoiled, as from an impassable barrier, and for a while that path has been closed. But only for a while. Some happy accident, some more daring adventurer, it may be time itself, has shown that the darkness was but a cloud. The light of science has pierced it; the march of science has left it behind, and the impossibility of one generation is for the next but the record of a new triumph.—*English Mechanic*, Sept. 4.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

CAPELLA.

With reference to the changes of colour in Capella (last month's *A. R.*) it may be well to call attention to the following remarks in Humboldt's *Cosmos* iii. 113: "El Fergani, who as early as the middle of the 10th century observed at Rakka (Avacte) on the Euphrates, names as 'red stars' Aldebaran, and perplexingly enough, the now yellow, or at the utmost reddish-yellow, Capella." And in the note (216) Humboldt says, "Argelander remarks that Ptolemy joins together Capella and Mars as similar in colour, and that Riccioli, 1650, also reckons Capella with Antares, Aldebaran, and Arcturus, among the red stars."

Firuzabadi also (1350) calls it a "red star" (Hyde on Ulugh Begh). Smyth (*Cycle*) makes it "bright white."

GEORGE J. WALKER.

METEORS.

Dear Sir,—A very fine meteor was seen here at 23 minutes past 11, on Tuesday the 7th.

I did not see it at first, but heard that it rose upwards from the S W., bursting like a sky-rocket into a number of pieces, then fading away and bursting out again. At first it was of a blue colour. It was sufficiently brilliant to light up the country. When I saw it it had just passed above *α* Andromedæ, and was of a decided mauve tint and double. It rushed along at a great speed, with an unsteady flickering light of great brilliancy, and disappeared near the cluster in Perseus. It left no train, but was followed by a few sparks. One minute and three quarters after disruption I heard a double explosion, like the firing of a double-barrelled gun at a distance, followed for about 15 seconds by a rolling sound like distant thunder. I also heard that on the Friday previous (the 3rd) a bright meteor was seen just before 10 p.m., bursting into several red sparks. It went about in a direction N. to S.

The 10th of August was cloudy here, and the 11th partially so, and I only saw 16 meteors between 9 and 10.30. One was about equal to Venus

in brilliancy, of a green-blue colour, with a very thin tail. It burnt very steadily, and appeared in Pegasus, falling from the direction of Hercules.

Writtle, near Chelmsford: Yours truly,
Sept. 13, 1875. HENRY CORDER.

THE RING OF LIGHT AROUND VENUS.

Sir,—With reference to the concluding portion of Mr. Proctor's note in the September number of the *Astronomical Register*, I may mention that the value of "about 2°" for the distance from the centre of the sun that Venus might have and appear surrounded by a ring of light, from the refraction of its atmosphere, was obtained simply by reversing the formulæ given by Clausius and Mädler, for the determination of the horizontal refraction of the atmosphere of Venus by measurements of the apparent prolongation of its cusps. As I am and have been much engaged, this formula has been taken on trust, and as it by reversal gives some 1° 53′ for the distance of Venus from the sun when it would appear surrounded by a ray of light, in round numbers this may be taken as 2° as done.

The interpretation put by Mr. Proctor on the observations of Prof. Lyman, as far as I understand, is not that which Prof. Lyman does, as he, like the earlier observers Mädler and Clausius, regards the ring as arising from the direct refraction of the solar rays to the light. And though a small proportion of the rays may be derived from the reflection from the dimly illuminated surface of Venus, yet the greater portion seem indubitably, in the case in question, to arise from the direct refraction of the solar light rays to the earth. It would appear questionable whether a belt of the surface of Venus illuminated very dimly by the rays passing through the longest path in the densest portion of the atmosphere of the planet, and then dispersed by reflection from the surface, so that few only would reach the earth, would be visible, if this belt had an apparent breadth of under one-hundreth of a second of arc. In the case of Prof. Lyman's observation the directly refracted rays would be much brighter than any derived from reflection from the surface.

Yours truly,
E. NEISON.

MOON.

In the 24th volume of the *Monthly Notices* of the Royal Astronomical Society, on page 21, a diagram is given of the outline of the moon as seen by the Rev. Henry Cooper Key on Sept. 20, 1863, and on page 207 of the same volume Mr. Lassell has given a sketch of a portion of the outline as seen by him on May 21, 1864. The moon's libration on Oct. 14, 1875, will be approximately the same as it was on May 21, 1864; and on the following evening, Oct. 15, approximately the same as on Sept. 20, 1863, so that observers will have a chance of making some useful contributions towards the satisfactory settlement of the question raised by Mr. Key's diagram, by carefully delineating the moon's rim and by determining the exact locality and amount of the apparent depressions on and about Oct. 14, the night of full moon.

Is it sufficient to call the attention of possessors of telescopes to the chance of doing something useful? Or must it be explained and urged that the opportunity should not be neglected?

A. MARTH.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN OCTOBER, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zone XXVIII. British Association map, 65° to 70° N. latitude.

Thirty degrees from the moon's western limb, or in 60° W. longitude, Boussingault (399), which extends over ten degrees. Twenty degrees further east Manzinus (401), extending over fifteen degrees. Fifteen degrees east of Manzinus, Curtius (404) extending to nearly the first meridian. In 2½° of E. longitude, Moretus (262) the west edge; the north part of the floor of this crater extends to 12½° of E. longitude, it has a fine central hill (see Webb's *Celestial Objects*, third edition, p. 112). To the north of Moretus is the much smaller crater Cysatus (264), eastward of which is Gruemberger (265), the three forming a fine group to the south of Terra Photographica (448). 7½° east of Gruemberger is Klaproth (255), the north part, which covers ten degrees of longitude. 5° east of Klaproth is the west edge of Wilson (253); the north part of the floor of this crater is in this zone, and its east border is in 40° E. longitude, the west edge of Kircher (252) being on the same meridian. The east border of Kircher is on the 45th meridian. There are two unnamed craters east and west, adjoining Kircher, and another between 55° and 60° E. longitude in the south part of the walled plain Bailly (245). The eastern limb of this zone is indented by the Doerfel mountains (246), marked *Montes Leibnitz* by B. and M. (see Webb's *Celestial Objects*, third edition. p. 111, also B. and M.'s *Der Mond*, p. 332, § 347, and Schröter's *Fragments*, vol. I., pp. 126 to 138, § 70 to 72, and vol. II. pp. 359 to 361, § 925 to 927). T IV. figs. 5 and 6, and T LXIII. figs. 1 and 2 are representations of these mountains as seen by Schröter, those in T LXIII. on the sun's disc during an eclipse.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat. of the centre of the sun's disc.	Angle of position of sun's axis.
1875.	°	°	°	°
Oct. 1	351·74	+13·21	+6·63	26·21
2	4·95	·21	6·57	26·27
3	18·16	13·21	+6·52	26·32
4	31·37	·21	6·47	26·37
5	44·58	·21	6·41	26·41
6	57·79	·21	6·35	26·44
7	71·00	·20	6·29	26·47
8	84·20	·21	6·22	26·49
9	97·41	·21	6·16	26·50
10	110·62	13·20	+6·09	26·50
11	123·82	·21	6·02	26·50
12	137·03	·21	5·95	26·49
13	150·24	·21	5·88	26·47
14	163·45	·20	5·80	26·44
15	176·65	·21	5·73	26·41
16	189·86	·20	5·65	26·37

17	203·06	13·21	+5·57	26·32
18	216.27	·20	5·49	26·26
19	229·47	·21	5·41	26.19
20	242·68	·20	5·32	26·12
21	255·88	·21	5·24	26·04
22	269·09	·20	5·15	25·95
23	282·29	·20	5·06	25·86
24	295·49	13·20	+4·97	25·75
25	308·69	·21	4·87	25·64
26	321.90	·20	4·78	25·52
27	335·10	·20	4·68	25·40
28	348·30	·20	4·59	25·26
29	1·50	·20	4·49	25·12
30	14.70	·21	4·39	24·97
31	27·91	13·20	+4·29	24·81
Nov. 1	41·11		4·19	24·64

A. M.

THE PLANETS FOR OCTOBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	23 38 42	S. 14 39½	6″·4	1 19·2
	9th	24 29 45	S. 18 2½	6″·8	1 18·8
	17th	14 46 42	S. 19 27½	8″·3	1 4·2
	25th	14 35 36	S. 17 25	9″·7	0 21·7
Venus ...	1st	12 38 57	S. 2 49½	9″·6	* *
	9th	13 15 43	S. 6 50	9″·8	0 4·9
	17th	13 53 5	S. 10 42½	9″·8	0 10·7
	25th	14 31 23	S. 14 17	9″·8	0 17·5
Mars ...	1st	19 10 36	S. 25 29½	13″·5	6 30·6
	9th	19 32 4	S. 24 34½	12″·7	6 22·8
	17th	19 53 47	S. 23 28	12″·1	6 10·4
	25th	20 15 49	S. 22 9½	11″·3	6 0·9
Saturn ...	1st	21 30 49	S. 16 12½	16″·6	8 50·1
	9th	21 29 50	S. 16 17	16″·4	8 17·7
	17th	21 29 16	S. 16 9	16″·2	7 45·7
	25th	21 29 8	S. 16 19	16″·0	7 14·1
Neptune ...	4th	2 2 38	N. 10 32½	...	13 9·4
	20th	2 0 59	N. 10 23½	...	14 14·8

Mercury is badly situated for observation, setting 26 minutes after sunset on the 1st, the interval decreasing.

Venus is too close to the sun to be well seen.

Mars may be fairly observed, setting nearly five hours after the sun at the beginning of the month, the interval gradually increasing.

Saturn sets 1h. 30m. after midnight at the beginning of the month, and so earlier each night. He sets on the last day nearly half-an-hour before midnight.

Neptune is in opposition to the sun on the 25th.

ASTRONOMICAL OCCURRENCES FOR OCTOBER, 1875.

DATE.		Principal Occurrences. h. m.		Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m. Saturn
Fri	1	5 11 12	Conjunction of Moon and Mercury, 0° 13′ S. Conjunction of Moon and Jupiter, 3° 38′ N. Conjunction of Mars and ψ Sagittarii (3·6m.) W.	1st Tr. E.	6 4	8 50·1
Sat	2		Sidereal Time at Mean Noon, 12h. 43m. 11·43s.			8 46·0
Sun	3		Sun's Meridian Passage 10m. 25·53s. before Mean Noon			8 42·0
Mon	4	18	Conjunction of Jupiter and Mercury 3° 56′ S.	2nd Tr. I.	5 57	8 37·9
Tues	5					8 33·8
Wed	6					8 29·8
Thur	7	15 4 5	Conjunction of Moon and Mars 2° 23′ N. ☽ Moon's First Quarter			8 25·7
Fri	8		Saturn's Ring: Major axis=40″·64 Minor axis=9″·95	1st Tr. I.	5 52	8 21·7
Sat	9	23	Conjunction of Moon and Saturn, 2° 47′ N.	1st Ec. R.	5 36 45	8 27·7
Sun	10					8 13·7
Mon	11			The		8 9·7
Tues	12			Satellites		8 5·6
Wed	13			of		8 1·6
Thur	14	11 14 5 20 6 7	○ Full Moon Occultation of ζ¹ Piscium (4½) Reappearance of ditto	Jupiter invisible		7 57·6
Fri	15	8 27	Near approach of 19 Arietis (6) Illuminated portion of disc of Venus=0·995 Illuminated portion of disc of Mars=0·847	from the 10th.		7 53·6
Sat	16	9 20 10 14	Occultation of ζ Arietis (4½) Reappearance of ditto			7 49·7

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn.
Sun	17	12 28 12 27	Occultation of χ^1 Tauri (5½) Reappearance of ditto Sidereal Time at Mean Noon 15h. 42m. 19·74s.			7 45·7
Mon	18	25 21	Near approach of B.A.C. 1746 (6½) Sun's Meridian Passage 14m. 32·89s. before Mean Noon	The Satellites of Jupiter invisible through his nearness to the Sun.		7 41·7
Tues	19	10 25 11 43 12 43 14 9	Near approach of B.A.C. 2097 (6½) Occultation of 49 Aurigæ (5½) Reappearance of ditto Near approach of 54 Aurigæ (6)			7 37·8
Wed	20	14 41	Near approach of *c* Geminorum (6)			7 33·8
Thur	21	2 13	☾ Moon's Last Quarter			7 29·8
Fri	22					7 25·9
Sat	23	0	Mars in quadrature with Sun			7 21·9
Sun	24	17 36 18 26 21 23	Occultation of σ Leonis (4) Reappearance of ditto Conjunction of Jupiter and Mercury 0° 21′ S. Opposition of Neptune			7 18·0
Mon	25	12	Conjunction of Venus and Mercury 2° 38′ S.			7 14·1
Tues	26	1	Conjunction of Jupiter and Mercury 2° 52′ S.			7 10·1
Wed	27					7 6·2
Thur	28	17 12 22	● New Moon Conjunction of Moon and Mercury 1° 49′ N. Saturn's Ring: Major axis=39″·36 Minor axis=9″·68			7 2·5
Fri	29	6 16 18	Conjunction of Moon and Jupiter, 4° 2′ N. Conjunction of Moon and Venus 3° 51′ N. Inferior conjunction of Mercury and Sun			6 58·5
Sat	30					6 54·6
Sun	31					6 50·7
NOV. Mon	1					6 46·8

EPHEMERIS OF THE SATELLITES OF SATURN.

The rectangular co-ordinates of the three inner satellites and the apparent distances of Titan and Iapetus, are expressed in semi-diameters of the planet's equator.—" pos."=angle of position.

$+x$	**East of minor axis of ring.**	$+y$	**North of major axis of ring.**
$-x$	**West " " "**	$-y$	**South " " "**

At 20h. Greenwich Sidereal Time.

1875. Oct.	Tethys. x	y	Dione. x	y	Rhea. x	y	Titan. pos.	dist.	Iapetus. pos.	dist.
1	−0·8	−1·2	−3·8	−1·2	−7·5	+1·2	118·4	11·8	268·5	50·2
2	+1·6	+1·2	−1·3	+1·5	+3·5	+2·0	151·8	6·1	268·8	52·7
3	−2·5	−1·1	+5·6	−0·8	+8·7	−0·5	227·9	6·7	269·0	54·9
4	+3·2	+0·9	−6·0	−0·5	−0·3	−2·2	256·6	12·4	269·3	56·8
5	−3·8	−0·8	+2·4	+1·5	−8·8	−0·3	267·2	17·4	269·5	58·4
6	+4·3	+0·6	+2·9	−1·4	−2·9	+2·1	273·7	20·1	269·7	59·6
7	−4·7	−0·4	−6·2	+0·4	+7·8	+1·1	279·5	19·8	269·9	60·5
8	+4·9	+0·2	+5·3	+0·9	+5·8	−1·7	286·5	16·5	270·1	61·1
9	−5·0	0·0	−0·7	−1·6	−5·6	−1·7	229·3	10·9	270·3	61·2
10	+4·9	−0·2	−4·3	+1·2	−7·8	+1·1	342·8	5·3	270·5	61·0
11	−4·7	+0·4	+6·4	0·0	+2·8	+2·1	58·8	7·7	270·7	60·4
12	+4·3	−0·6	−4·1	−1·2	+8·9	−0·3	80·6	13·9	270·9	59·5
13	−3·8	+0·8	−1·0	+1·6	+0·4	−2·2	89·4	18·7	271·1	58·2
14	+3·1	−1·0	+5·4	−0·8	−8·7	−0·5	95·3	20·9	271.3	56·5
15	−2·4	+1·1	−6·1	−0·4	−3·6	+2·0	100·7	20·3	271·5	54·5
16	+1·6	−1·2	+2·7	+1·4	+7·4	+1·2	107·4	17·0	271·8	52·1
17	−0·7	+1·2	+2·6	−1·4	+6·3	−1·6	119·1	11·6	272·0	49·5
18	−0·2	−1·2	−6·1	+0·5	−5·1	−1·8	153·6	6·1	272·4	46·5
19	+1·1	+1·2	+5·4	+0·8	−8·3	+0·9	229·0	6·8	272·8	43·2
20	−1·9	−1·1	−1·1	−1·6	+2·1	+2·1	256·9	12·6	213·2	39·6
21	+2.7	+1·0	−4·1	+1·2	+8·9	−0·1	267·3	17·5	273·7	35·8
22	−3·4	−0·9	+6·4	0·0	+1·2	−2·2	273·9	20·1	274·3	31·8
23	+4·0	+0·7	−4·4	−1·2	−8·5	−0·7	279·6	19·8	275·1	27·6
24	−4·5	−0·6	−0·7	+1·6	−4·3	+1·9	286·7	16·4	276·2	23·2
25	+4·8	+0·4	+5·2	−0·9	+6·9	+1·4	299·7	10·8	277·9	18·7
26	−5·0	−0·1	−6·2	−0·4	+6·8	−1·4	344·2	5·3	280·6	14·0
27	+5·0	−0·1	+3·0	+1·4	−4·4	−1·9	59·3	7·8	286·0	9·4
28	−4·8	+0·3	+2·3	−1·5	−8·4	+0·7	80·7	14·0	302·	4·9
29	+4·6	−0·5	−6·0	+0·5	+1·3	+2·2	89·5	18·7	16·	2·6
30	−4·1	+0·7	+5·6	+0·8	+8·9	+0·1	95·3	20·9	66·	6·1
31	+3·6	−0·9	−1·4	−1·5	+1·9	−2·1	100.7	20·3	76·9	10·7
Nov.										
1	−2·9	+1·0	−3·8	+1·3	−8·2	−0·9	107·4	16·9	81·2	15·4

Approximate times of the conjunctions of the satellites with the centre of the planet, or of their passing in the direction of the minor axis of the ring.

Gr. Sid. Time.	h.		y
Oct. 1	13·2	Dione	—1·6
	18·8	Tethys	—1·2
	0·2	Encel.	+1·0
2	13·1	Rhea	+2·2
	16·7	Encel.	—1·0
	17·1	Tethys	+1·2
	22·2	Dione	+1·6
	6.8	Titan	—5·0
	9·2	Encel.	+1·0
3	16·3	Tethys	—1·2
	1·7	Encel.	—1·0
	7·1	Dione	—1·6
4	15·0	Tethys	+1·2
	18·2	Encel.	+1·0
	19·5	Rhea	—2·2
	10·7	Encel.	—1·0
5	13·7	Tethys	—1·2
	16·0	Dione	+1·6
	3·2	Encel.	+1·0
	12·4	Tethys	+1·2
6	19·6	Encel.	—1·0
	1·0	Dione	—1·6
	1·8	Rhea	+2·2
	11·1	Tethys	—1·2
	12·1	Encel.	—1[illegible]
7	4·6	Encel.	—1·0
	9·9	Tethys	+1·2
	9·9	Dione	+1·6
8	21·1	Encel.	+1·0
	8·2	Rhea	—2·2
	8·6	Tethys	—1·2
9	13·6	Encel.	—1·0
	18·8	Dione	—1·6
	6·1	Encel.	+1·0
	7·3	Tethys	+1·2
10	22·6	Encel.	—1·0
	2·3	Titan	+4·8
	3·7	Dione	+1·6
	6·0	Tethys	—1·2
11	14·5	Rhea	+2·2
	15·0	Encel.	+1·0
	4·7	Tethys	+1·2
	7·5	Encel.	—1·0
	12·7	Dione	—1·6
12	0·0	Encel.	+1·0
	3·4	Tethys	—1·2
13	16·5	Encel.	—1·0
	20·9	Rhea	—2·2
	21·6	Dione	+1·6
	2·1	Tethys	+1·2
	9·0	Encel.	+1·0
14	0·9	Tethys	—1·2
	1·5	Encel.	—1·0
	6·5	Dione	—1·6

Gr. Sid. Time.	h.		y
Oct. 15	18·0	Encel.	+1·0
	23·6	Tethys	+1·2
	3·2	Rhea	+2·2
	10·5	Encel.	—1·0
16	15·5	Dione	+1·6
	22·3	Tethys	—1·2
	2·9	Encel.	+1·0
17	19·4	Encel.	—1·0
	21·0	Tethys	+1·2
	0·4	Dione	—1·6
	9·6	Rhea	—2·2
	11·9	Encel.	+1·0
18	19·7	Tethys	—1·2
	4·4	Encel.	—1·0
	6·1	Titan	—5·1
	9·3	Dione	+1·6
19	18·4	Tethys	+1·2
	20.9	Encel.	+1·0
	13·4	Encel.	—1·0
20	15·9	Rhea	+2 2
	17·2	Tethys	—1·2
	18·3	Dione	—1·6
	5·9	Encel.	+1·0
21	15·9	Tethys	+1·2
	22·4	Encel.	—1·0
	3·2	Dione	+1·6
22	14·6	Tethys	—1·2
	14·9	Encel.	+1·0
	22·3	Rhea	—2·2
	7·3	Encel.	—1·0
	12·1	Dione	—1·6
	13·3	Tethys	+1·2
23	23·8	Encel.	+1·0
	12·0	Tethys	—1·2
24	16·3	Encel.	—1·0
	21·1	Dione	+1·6
	4·6	Rhea	+2·2
	8·8	Encel.	+1·0
	10·7	Tethys	+1·2
25	1·3	Encel.	—1·0
	6·0	Dione	—1·6
	9·5	Tethys	—1·2
26	17·8	Encel.	+1·0
	2·0	Titan	+4·8
	8·2	Tethys	+1·2
	10·3	Encel.	—1·0
	11·0	Rhea	—2·2
27	14·9	Dione	+1.6
	2·8	Encel.	+1.0
	6·9	Tethys	—1·2
28	19·3	Encel.	—1·0
	23·9	Dione	—1·6
	5·6	Tethys	+1·2
	11·7	Encel.	+1·0

Gr. Sid. Time.	h.		y	Gr. Sid. Time.	h.		y
Oct. 29	17·4	Rhea	+2·2	Oct. 31	17·8	Dione	—1·6
	? 22	Iapetus	+2·7		23·7	Rhea	—2·2
	4·2	Encel.	—1·0		1·8	Tethys	—1·2
	4·3	Tethys	—1·2		5·7	Encel.	+1·0
	8·8	Dione	+1·6	Nov. 1	22·2	Encel.	—1·0
30 ?	19	Iapetus eclipsed			0·5	Tethys	+1·2
	20·7	Encel.	+1·0		2·7	Dione	+1·6
	3·1	Tethys	+1·2			A. MARTH.	
	13·2	Encel.	—1·0				

Observers will oblige by communicating the times of any of the conjunctions which they may have succeeded in observing. Or has not one of the predicted conjunctions been secured? A.M.

A Practical School of Astronomy, the first in France, and probably the only one in Europe, has just been opened under the direction of Captain Mouchez, at the Observatory of Montsouris, close to Paris. The instruction is gratuitous, but the pupils are required to show sufficient practical knowledge to follow the practical studies with profit.—*Globe.*

Errata.—Page 111, line 8 from top, for *Signi* read *Cygni;* page 137, bottom line, for *flexture* read *flexure;* page 227, line 19 from top, for *Mercury* read *Venus.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sept., 1875

Baron, Rev. T.
Dale, R.
Lean, W. S.
Potter, T.
Worthington, F.

To Dec., 1875.

Baffham, T. H.
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When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or *penny* postage stamps, but the Editor will not be liable for loss in transmission.

Post Office Orders for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage to all parts of Great Britain and Ireland) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications, Letters, Articles for insertion, &c., must be sent to the Rev. J. C. Jackson, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 155. NOVEMBER. 1875.

ADVANCEMENT OF SCIENCE.

The leading article in No. 154 (October, 1875) is suggestive of scientific thoughts bearing on the advancement (truly so called) of science in this country. The writer of this article complains that at the last meeting of the British Association "papers were admitted that under no conceivable stand-point could be termed scientific." Whatever may have contributed to this result, or by whose inadvertence it has been permitted, it is by no means the first time that animadversions have been made on the downward progress of the Association. In the *Astronomical Register*, No. 117 (September, 1872), more than three years since, we are told that "Twenty years ago the British Association for the Advancement of Science put its hand to a work of no small magnitude and of no little importance." It does not appear from your article in the number just quoted that this work was persevered in, for its author refers to its desultory character, and alludes to its having been given up by the Association on account of its magnitude. Whether this is one of the works promoted by the Association under the superintendence of a committee consisting of a string of brilliant names, it is not necessary here to enquire, nor does it much matter whether the withdrawal from it of the support of the Association resulted from "cliquism," from any inherent defect in the work itself, or its want of brilliancy to attract the attention of the public, who as a general rule care little for inspecting the progress of an edifice while in course of erection, but oftentimes manifest no little impatience until it is completed. One thing is certain, that instead of a stronger

impulse and a more systematic direction being given to the work to which particular allusion was made in September, 1872, it has been allowed to languish, and of late the interest taken in it by astronomers appears to have declined altogether, and this seems to be the more remarkable as the last portion of the work of the Association to which it put its hand in 1852 is mentioned in No. 118 (October, 1872) as having terminated successfully.

Our own humble contributions to this work have appeared from month to month for some years past, and as we hope in December to complete that portion of it commenced in July, 1873, viz., the specifying of prominent and named objects on the moon's surface, arranged in zones of the British Association map, projected and began in 1866, we propose revising each zone, giving such additional information as we have been able to glean, and especially pointing out those craters and formations still destitute of names.

Our readers are doubtless fully aware that it is now more than 200 years since the nomenclature of lunar spots was commenced. This is a work of slow progress, presenting nothing striking to the general reader, who recognises only a string of names, although for the most part brilliant, yet possessing no interest for him, but for the selenographer of great importance, inasmuch as it helps him in registering appearances and seeking for changes. The latest published list, which we have in *Webb's Celestial Objects for Common Telescopes*, third edition, contains 494 names. The reader will scarcely need reminding that we have especially mentioned in our monthly lists several unnamed craters, and it is for such craters that we intend in our monthly notices of lunar objects next year to propose names.

The compilation of a list of names is not a very agreeable or interesting occupation, nevertheless in prosecuting selenographical enquiries some method in designating objects is indispensable. Although the British Association has relinquished so necessary a work as recording every object that can be distinguished on the moon's surface by the aid of telescopes, it has bequeathed to us a method by which small, and it may be insignificant, objects and phenomena connected with them may be readily and permanently recorded. It is true that some little trouble is requisite to master this method, and it is not easy for isolated observers to use it, but on the other hand if a band of observers were organised with a competent chief as its head, a considerable amount of progress in selenography might be effected, and a much better knowledge of the moon's surface obtained than we possess at present. The published reports of the British Association not only contain an account of the method in full,

but also maps and catalogues of the regions already surveyed. Since the publication of Webb's list in 1873, the following names have been proposed: "Darwin" for the crater south-east of Archimedes, No. 120 in Webb's map. This crater, which is between Archimedes and Beer and Mädler 446 and 447, is not in Webb's map, it is between and nearly in a line with the large and two smaller craters, its number is 495. For the large formation west of W. C. Bond, 465, the name "Cicero" is proposed, number 496, its outline is not in Webb's map. It is proposed to restore the name "Hell" to the formation in which B. and M.'s "Hell" is situated. Schröter observed and described at great length this formation; his drawings of it are in T XLVI of his *Fragments*, its number is 497, that of B. and M.'s "Hell" is 184, for which the name "Sheepshanks" is proposed, number 503. For Mösting A, number 498, which, as our readers are aware, has been proposed for a point of general reference for the moon's surface, the name "Kaiser" is suggested. Have any steps been taken for determiniug the selenographical latitude and longitude of this spot?

D'ARREST ON THE DISCOVERY OF NEW REMARKABLE STELLAR SPECTRA OF SECCHI'S 3rd and 4th TYPES.

No. I.

(From *Astronomische Nachrichten*, No. 2,009.)

Since the attempts to furnish a direct chemical interpretation of the metallic absorption lines in the spectra of certain of the principal stars—attempts that did not fail to raise objections on the part of astronomers—have now begun to occupy a less prominent position, the prismatic analysis of the light of the fixed stars, on the contrary, acquires in another direction, and that somewhat unexpectedly, considerable astronomical interest. There is no question here of the nebulæ, but what I refer to is the connection that is now clearly established between the occurrence on the one hand of spectra with strongly marked, more or less broad, darker or fainter absorption bands, and the reddish or red colour of certain stars, for the most part variable, on the other hand.

Almost simultaneously with the publication of Schjellerup's Catalogue of the isolated red stars, in the year 1866, Secchi, who had already previously discovered a few of the finest specimens of stars of the third type, began instituting a systematic search for stars of this category, and he soon found himself compelled to

increase his *three* original types of stellar spectra by the addition of a *fourth* one. (In 1868, *Memor. second p.*8.) The knowledge we have gained in this field was thereby materially extended, and the investigation of the character of the light of stars appears to me to have become at the present time of at least as much importance as the study of the phenomena of the variability of their light. Taking this view of the matter, there has hitherto been made but a commencement, first of all by *Padre Secchi,* and subsequently by *Dr. Vogel,* in sifting the abundant material in hand. The contribution I now offer contains only the *most remarkable* among the decided zonal spectra of the stars of the northern heavens that I have as yet come across in my spectroscopic review thereof, and which *have not* hitherto been made mention of in connection with this peculiar quality of their light. For this reason not a single star contained in the well-known catalogue of Schjellerup figures among those that follow.

I hope to be able to continue these communications, inasmuch as it appears desirable to become acquainted approximately with what the heavens exhibit in this respect. Indeed, speaking in a general way, what *Secchi* said in 1868 of spectra of this character is valid even yet, namely, that a good harvest may be looked for therefrom, yet such a harvest requires much labour and perseverance, for though the heavens are tolerably rich in columnar spectra not strongly pronounced with fine, delicate bands, distinctive representatives of the 3rd, and especially of the 4th type, are rare.

As the time has most assuredly not yet arrived for drawing general conclusions, I confine myself to a communication of what follows, observing simply that the coincidence of sharply marked columnar spectra with reddish colour, or with a probable variability of the stars in question, is not as yet recognised to prevail universally, and to be altogether without exception. In this communication I follow closely, as I shall also do in the sequel, the *Bonner Durchmusterung.**

Here, as in the sequel—

Argel Oe.	denotes,	Argelander Oetzen.
Arm.	,,	Armagh.
Br.	,,	Bonner Beobachtungen (?).
Fedor.	,,	Fedorenno
Gr.	,,	Groombridge.

* For the convenience of the readers of the *Astronomical Register*, the indications of the Bonn Working Catalogue are given in Right Ascension and Declination as well, through the kindness of the Director of a foreign observatory.

LL.	„	La Lande.
Lm.	„	Lamont.
P.	„	Piazzi.
R.	„	Rumker's Catalogue of 12,000 stars.
Redh.	„	Redhill.
W.	„	Weisse's Catalogue of Stars between $-15°$ and $+15°$.
W.^{2}	„	Weisse's Catalogue of stars between $+15°$ and $+45°$.
Wash.	„	Washington.

1. B. D. + 17. 4370

R. A. 20h. 31m. 18s. Decl. $+17° 45'·5$. Mag. 7·0.

Very beautiful columnar spectrum of the 3rd type, with the usual but strikingly dark bands up into the violet. Star yellow reddish.

2. B. D. + 18. 4675. LL. 40682.

R. A. + 20h. 53m. 50·9s. Decl. $+ 18° 46'·7$. Mag. 5·9.

Colonnade spectrum; not readily to be overlooked in spite of the insignificant brilliance of the star. 3rd type, pretty much as δ^2 *Lyræ*

3. B. D. + 21. 4952; LL. 46146; W.^{2} 23,558.

R. A. 23h. 26m. 13·7s. Decl. $+ 21° 43'·4$. Mag. 6·0.

Reddish star with a splendid banded spectrum, like *a Herculis*, in the numerous dark stripes as far as up into the extra blue region. One of the finest examples of the 3rd type.

4. B. D. + 24. 3759, 6 *a Vulpec*; B. A. C. 6674.

R. A. 19h. 22m. 39·6. Decl. $+24° 22'·2$. Mag. 4·2.

Yellow star. The spectrum is one of the most distinctly pronounced of the 3rd type. The bands remarkably dark and sharp. The columns occupy the stereotyped position.

5. B. D. + 30. 3409.; W.^{2} 18. 1861.

R. A. 18h. 59m. 23·1s. Decl. $+30° 31'·0$. Mag. 6·5

Star 6·5 or 7 with a very distinct columnar spectrum. $= \delta^2$ *Lyræ*. Type 3.

6. B. D. + 31. 3199; 104 A *Hercl.*; B.A.C. 6178.

R. A. 18h. 6m. 25·7s. Decl. $+31° 21'·8$. Mag. 5·0.

Remarkably beautiful columnar spectrum; pure 3rd type; R *Lyræ (v. Camphausen, Vogel)* with sharp separation of the stripes of light. Star yellowish red.

7. B. D. + 34. 2773; 20 ν^2 *Cor. Boreal.* B.A.C. 5479.

R. A. 16h. 16m. 54·0s. Decl. $+ 34° 9'·6$. Mag. 5·2.

Star bright orange, with remarkably strongly marked zonal spectrum, agreeing exactly with the following object.

8. B. D. 34. 2774; 21 ν^2 *Cor. Boreal.* B.A.C. 5480.

R. A. 16h. 17m. 1·8s. Decl. $+34° 2'·5$. Mag. 5·3.

Colour and conspicuous spectrum precisely like the above. Both are probably physically connected.

9. B. D. + 34. 4500; LL. 42342; W.[2] 21.889.

R. A. 21h. 35m. 54·5s. Decl. + 34° 51′·0. Mag. 6·2.

Strikingly red star of 6·7 magnitude. Rare spectrum of the 4th type, decidedly not of the 3rd. In the red there are a few narrow bands not very readily to be made out, while in the green and blue there are broad dark intervals; after that the spectrum breaks suddenly off, and the more refrangible rays are entirely wanting.

10. B. D. + 36. 2772; LL. 30500.

R. A. 16h. 37m. 56·0s. Decl. +36° 47′·4. Mag. 7·7.

Beautiful columnar spectrum. Is one of the accompanying stars of the great *Hercules* nebula (Halley), which itself shows a prodigious number of faint continuous spectra. Messier 92 does the same.

11. B. D. +37. 3636; LL. 37866.

R. A. 19h. 45m. 35·4s. Decl. + 37° 27′·9. Mag. 7·0.

For the faintness of the star, a striking and very sharply pronounced colonnade spectrum, evidently of the 3rd type.

12. B. D. + 38. 3780; 19 *Cygni*. LL. 37858,

R. A. 19h. 45m. 25·9s. Decl. +38° 21′·2. Mag. 5·5.

Easily recognisable banded spectrum of the 3rd type. The dark intervals are perfectly distinct.

13. B. D. + 39. 3476; W.[2] 1018, 19.

R. A. 18h. 33m. 19·2s. Decl. +39° 32′·8. Mag. 6·5.

Star with a surprisingly beautiful spectrum of type 3; one of the best pronounced of the class of *α Hercul.* The spectrum is identical with that of δ^2 *Lyræ* (*Secchi*) and with R *Lyræ*.

14. B. D. + 42. 2749; W.[2] 16,1347.

16h. 42m. 41·6s. Decl. +42° 30′·6. Mag. 6·5.

Splendid example of the 3rd class, the spectrum is broken up into zones divided by dark intervals as readily as *α Herculis*. Colour of the star is light brown. There are other columnar spectra hereabouts, but less remarkable ones.

15. B. D. + 43. 2542; 2 *Hercul*; Br; P., &c.

R. A. 15h. 49m. 48·6s. Decl. +43° 34′·1. Mag. 5·5.

Beautifully channeled spectrum, the divisions of which cannot, however, be followed beyond the blue. Is like *β Pegasi*.

16. B. D. + 46. 2293; 74 *Hercul*; Arm, &c.

R. A. 17h. 16m. 17·0s. Decl. +46° 22′·3.

Delicate but well divided bands through all colours; class 3. A remarkable agreement between all the absorption spectra of this type over the entire heavens, but great difference obtains as to the sharpness and degree of darkness in the divisions; the transition

from *a Herculis* to continuous linear spectra takes place by degrees, of which instances in all intermediate stages are met with in the heavens.

17. B. D. + 49. 2531; 42 Hercul; Str. pos. m. 1852, &c.
R. A. 16h. 34m. 49·7s. Decl. + 49° 13'·1. Mag. 5·0.

Sharp columnar spectrum; type 3, star very yellow. The bluish companion exhibits a uniform spectrum. Struve, however, speaks of the principal star as being "egregie flava."

18. B. D. + 55. 1625; 83 Urs. Maj.; Br.; P.; Gr., &c.
R. A. 13h. 35m. 15·4s. Decl. +55° 24'·0. Mag. 5·5.

Star colourless, with very beautiful columnar spectrum of type 3.

19. B. D. + 60. 1461; P.; Gr.; Argel. Oe. 13681.
R. A. 13h. 23m. 8·4s. Decl. +60° 42'·7. Mag. 5·3.

Star shows a clear colonnade spectrum. The bands very distinct, though tolerably delicate. Type 3.

20. B. D. + 66. 780; Fedor. 2181; Argel. Oe. 13158.
R. A. 12h. 50m. 41s. Decl. +66° 46'·8. Mag. 7·3.

Star of a strongly reddish colour, the extraordinarily remarkable spectrum consists of bright stripes of light, divided by broad dark interstices. The black bands are sharply bounded towards the red, so that this is a spectrum of *Secchi's* 4th type, or of order 3, class 2, according to *Vogel's* notation. This object calls for special investigation.

21. B. D. + 66. 878; Fedor. 2561; Gr. 2177; Radcl., &c.
R. A. 14h. 55m. 17s. Decl. +66° 31'·1. Mag. 4·5.

Star with a beautiful banded spectrum of the 3rd type, resembles *β Pegasi*. Peculiar, owing to the star being colourless, yet on four nights subsequently this star, too, was somewhat yellow.

22. B. D. + 70. 778; Fedor. 2428; Gr. 2091; Radcl., &c.
R. A. 14h. 9m, 24s. Decl. + 70° 6'·8. Mag. 5·3.

Yellow reddish star. Somewhat narrow bands, but very distinct, and easily visible in the usual position, extending through all colours up into the blue. The 3rd type.

Copenhagen: August, 1874. D'ARREST.

N.B.—The magnitudes of the stars, as stated above, do not in many cases agree with those assigned to them by D'Arrest.

		D'Arrest's Magnitudes.		In the translation.
1	...	7·8	...	7
2	...	6·7	...	5·9
3	...	?	...	6
4	...	5	...	4·2
5	...	7	...	6·5

6	?	5
7	?	5·2
8	?	5·3
9	6·7	6·2
10	8·3	7·7
11	8	7
12	6	5·5
13	7	6·5
14	7	6·5
15	?	5·5
16	?	4·5
17	?	5
18	?	5·5
19	6	5·3
20	7	7·3
21	5	4·5
22	5·6	5·3

(From *Astronomische Nachrichten,* No. 2,016.)

No. II.

(Continued from *Astronomische Nachrichten,* No. 2,009.)

While publishing the second series of the remarkable stellar spectra discovered at Copenhagen—some of them being of great beauty—I have only to premise the following by way of general observations.

As yet not a single decidedly *white* or *bluish star* has been met with that shows a sharply defined absorption spectrum, while there are many strikingly yellowish and reddish-yellow stars with uniform indifferent spectra, just as in the case of colourless stars. 61 *Cygni* may be cited as an example of this, the two components whereof, each being, as is known, of a deep yellow, or rather orange, colour, exhibit only indifferent spectra.

The leading prismatic character of stars of the third type is, as we gather from all the experience hitherto gained, almost for a certainty universally constant. As a rule it is true that at the red end of the spectrum the separation of the columns is more sharply pronounced, yet the instances are by no means rare where on the contrary the more refrangible end of the spectrum is distinguished by its columnar character, owing to it bearing the stamp of dark absorption bands. It, moreover, offers no difficulty to adduce examples in the heavens of all intermediate gradations of absorption bands, from simply a delicately intimated indication of stripes up to spectra that are entirely discontinuous, such as

that of *a Herculis.* In this gradation *the colour is not to be held as by any means decisive in the matter in all cases.* Guided thereby and by the experience above referred to, it appears to me that the conclusions drawn and the propositions now in vogue as to the relative age of the coloured stars and their relatively low condition of temperature cannot be admitted as trustworthy, and without encountering numerous exceptions presented by a detailed examination of the heavens.*

And even should the above conclusion, as far as the condition of temperature is concerned, not be, in a general way, altogether improbable, it is, nevertheless a hazardous one and not established spectroscopically; but with respect to the ages of the stars it is self-evident that it is more than hazardous, altogether incapable of being proved, and in my opinion entirely without foundation.

That we at present, with very few exceptions, can indicate stars of the 3rd and 4th type only down as low as the 6th and 7th magnitude is simply a consequence of the examination of the quality of the light of fainter stars being far too difficult a matter, or downright impracticable, with the optical arrangements now at our disposal. By those two Copenhagen series the total number of stars having remarkable spectra of the 3rd type is almost trebled, the number of those of the 4th type, on the other hand, is not materially increased. It is thus established that examples of the 4th type, with the exception of the variables and of the best known red stars (which do not find a place here), are only very rarely to be met with in the northern heavens. After a considerable interval it is possible that a third series of remarkable spectra may be further added; after which the northern hemisphere would not hold out much prospect of the enquiry being carried on further.

(1855·0).

1. B. D. — 1·4057; LL. 40182; W. 1069; Lm. 7832.
   R. A. 20h. 41m. 50·1s. Decl. — 1° 5′·6. Mag. 6·8.

Well marked columnar spectrum; the broad bands peculiarly dark in the green and blue. Star 7th magnitude.

2. B. D. — 0·4585; LL. 46859·60; Wash. 10544.
   R. A. 23h. 47m. 21·7s. Decl. — 0° 42′·2. Mag. 6·2.

* "We have classed them according to their ages. Stars coloured, stars yellow, stars white; the white are the hottest and youngest, the coloured stars are not so hot and are older."—*Nature*, vol. x. p. 350.—Meeting of the French Physicists at Lille, August, 1874. A mere attempt to carry out a classification of this kind would require quite another sort of materials, more comprehensive and more trustworthy than what we are in possession of.

Star 6·7 mag. Almost colourless. Peculiarly sharply divided dark bands. One of the most rare examples of the 3rd type.

3. B. D. + 9·5268; 77 *Pegasi*; B.A.C. 8250; Wash. 10464.
R. A. 23h. 36m. 1·1s. Decl. + 9° 31′·4. Mag. 5·0.

Nice, very distinct absorption bands, visible most clearly in the red and orange. Star yellowish.

4. B. D. + 14. 111; 57 *Piscium;* B.A.C. 211.
R. A. 0h. 38m. 59·9s. Decl. + 14° 41′·0. Mag. 5·0.

Star 6 mag. not of very intense colour, with very beautiful typical banded spectrum. The intervals are so well divided and dark that the spectrum resembles that of β *Pegasi.*

5. B. D. + 14. 1283; LL. 12245.46; W. 492.
R. A. 6h. 17m. 11·6s. Decl. + 14° 48′·6. Mag. 6·5.

Reddish star of 8 magnitude (not brighter) with irregular spectrum of the 4th type. Spectrum faint, it is true, but of surprising splendour. An especially bright place in the yellow. It looks like a broad stripe of light.

6. B. D. + 14. 4730; W. 1341.
R. A. 21h. 58m. 3·3s. Decl. + 14° 6′·9. Mag. 6 6.

Star 7·8 mag. without colour, occasionally yellowish. Normal colonnade spectrum with unusually sharply pronounced columns, divided by dark bands. Very sharply defined.

7. B. D. +16. 4153; W. XX. 3.
R. A. 20h. 1m. 31·8s. Decl. + 16° 15′·5. Mag. 6·5.

Star 6·8 mag. reddish yellow. Notwithstanding the faintness of the star sharply marked banded spectrum of 3rd type, even when the atmosphere was not favourable.

8. B. D. + 17. 55; 47 Piscium; B.A.C. 101.
R. A. 0h. 20m. 29·6s. Decl. + 17° 5′·1. Mag· 5·1.

Star 6 mag. inconsiderably yellow. Its spectrum almost as striking as β *Pegasi*, consequently a very conspicuous absorption spectrum of the 3rd type, with broad very dark intervals. Star on a subsequent night bright orange.

9. B. D. + 17. 4183; 13 *Sagittæ;* B.A.C. 6868.
R. A. 19h. 53m. 30·4s. Decl. + 17° 7′·2. Mag. 5·8.

Star 6 mag. with beautiful columnar-like spectrum. About such as δ *Sagittæ.*

10. B. D. + 17. 4401 not observed.
R. A. 20h. 38m. 49·8s. Decl. + 17° 34′·0. Mag. 6·8.

Argelander gives 6.8 as mag. of star, whereas on 10th Sept., 1874, it was of 10 mag. strikingly reddish. Variable? For the faintness of the star it shows an extreemly well pronounced banded spectrum; interstices very dark.

11. B. D. + 18. 277; 15 *Arietis;* B.A.C. 665.
R. A. 2h. 2m. 36·1s. Decl. + 18° 49′·0. Mag. 6·0.

Star almost colourless, yet its spectrum is broken up into splendid columns, apparently of the normal 3rd type. The bands dark and broad through the whole of the colours.

12. B. D. + 18. 875; 119 *Tauri*; B.A.C. 1726.

R. A. 5h. 23m. 42·8s. Decl. + 18° 28′·6. Mag. 4·4.

5 mag., yellow reddish. Admirable spectrum of 3rd type. All bands dark and broad. Resembles π *Aurigæ*.

13. B. D. + 18. 4240; 7 δ *Sagittæ*; B.A.C. 6783.

R. A. 19h. 40m. 55·2s. Decl. + 18° 10′·5. Mag. 4·0.

Extraordinarily beautiful spectrum of the 3rd type; columns sharp between very dark absorption bands. *Vogel* makes mention of this spectrum in No. 2,000 of the *Astronomische Nachrichten*, he has, however, doubtless seen it under unfavourable conditions; I found it repeatedly in August and September, 1874, extremely splendid.

14. B. D. + 21. 4555; LL. 41799·80; W. 536.

R. A. 21h. 22m. 22·3s. Decl. + 21° 33′·4. Mag. 5·5.

Star 7 mag., not brighter. Argelander 5·5 somewhat coloured. Pretty example of the 3rd type, the decided absorption bands in the normal position easily visible.

15. B. D. + 22. 3273; 98 *Herculis*; B.A.C. 6134.

R. A. 17h. 59m. 54·8s. Decl. + 22° 12′·3. Mag. 5·2.

Star yellowish; spectrum shows dark and broad bands through all zones of colour.

16. B. D. + 22. 3549; LL. 35507; W. 1660.

R. A. 18h. 53m. 50·9s. Decl. + 22° 36′·9. Mag. 6·5.

Star 7 mag., strikingly yellowish-red. Pure 3rd type, well marked and easily seen.

17. B. D. + 23. 4325; 2 *Pegasi*; B.A.C. 7474.

R. A. 21h. 23m. 23·2s. Decl. + 23° 0′·0. Mag. 4·5.

Star 6 mag., light orange. The dark intervals very strikiug in red and orange, but faint in the green and blue. A remarkable banded spectrum worthy of special examination.

18. B. D. + 31. 3075; LL. 32300; W. 1117.

R. A. 17h. 34m. 27·9s. Decl. + 31° 17′·1. Mag. 6·5.

Star light reddish yellow Beautiful zonal spectrum, which, however, requires a pure condition of the atmosphere. Observed several times.

19. B. D. + 34. 469; 15 *Triang*; B.A.C. 786.

R. A. 2h. 27m. 0·2s. Decl. + 34° 3′·0. Mag. 5·6.

Star 6 mag., exquisite normal zonal spectrum of the 3rd type, essentially identical with that of α *Ceti*. The statements as to the magnitude vary very considerably.

20. B. D. + 35. 2911; 61 *c Herculis*; LL. 31102; B.A.C. 5763.

R. A. 16h. 58m. 20·2s. Decl. + 35° 36'·9. Mag. 6·5.
Star 7·7 mag. strikingly faint; yellowish red. Spectrum with beautiful well divided bands.

21. B. D. + 37. 1336; 31 *v Aurigæ*; B.A.C. 1844.
R. A. 5h. 41m. 9·9s. Decl. + 37° 15'·5. Mag. 5·0.
Somewhat like *π Aurigæ* (Secchi) or *ρ Persei.* Beautiful example of this kind, although the bands are somewhat less broad.

22. B. D. + 51. 1295; Fedor. 1039; Gr. 1272; Radcl. 1898.
R. A. 7h. 2m. 5·4s. Decl. +51° 39'·0. Mag. 6·0.
Star 6 mag., yellowish. Spectrum with splendid columns through all the zones of colour.

23. B. D. + 61. 869; 1 *Lyræ*; Fedor. 863, Gr. 1111, &c.
R. A. 6h. 4m. 35s. Decl. +61° 31'·8. Mag. 5·5.
Star 6 mag., almost colourless, with beautiful colonnade spectrum. The second band in the red especially broad.

24. B. D. + 63. 543; Gr. 878; Radcl. 1310; B.A.C. 1470.
R. A. 4h. 38m. 33s. Decl. +63° 15'·0. Mag. 5·8
Spectrum of 3rd type, strongly pronounced; quite normal, bands very dark.

25. B. D. + 65. 369; Fedor. 599; Gr. 726; Arm. 781.
R. A. 3h. 36m. 17s.
Neat typical spectrum of 3rd kind. In the green the stripes do not stand out very well, but on the contrary very beautifully in the orange and red.

26. B. D. +81. 389; Gr. 1845; Radcl. 2782; Redh. 1784.
R. A. 11h. 52m. 38s. Decl. +81° 39'·7. Mag. 6·2.
Star orange, more strongly coloured than the neighbouring star. Redh. 1807, the bands of which are however fainter and tolerably difficult to discern. The spectrum of *Carrington* 1784 consists of columns perfectly separated with dark bands, sharply defined on one side.

27. B. D. + 82. 201; Gr. 1259; Radcl. 1887; Redh. 1027
R. A. + 7h. 0m. 18s. Decl. +82° 40'·5. Mag. 5·5.
"Reddish." Only pale yellowish. The spectrum splendid, in the form of columns with deep dark stripes throughout the whole extent. Star 5·6 magnitude; in October, 1874, almost colourless.

28. B. D. + 87. 51; Fedor. 860; Radcl. 1769; Redh. 956.
R. A. 6h. 31m. 7s. Decl. +87° 15'·1. Mag. 5·0.
The characteristic spectrum of the 3rd type, well developed. Stripes peculiarly dark in the red, orange, and yellow. At the beginning of October state of atmosphere unfavourable.

Supplement—Southern Stars.

1. 34 γ Eridani; B. A. C. 1234.
R. A. 3h. 51m. 15·9s. Decl. —13° 55′·4 (1855).
Star orange. Splendid zonal spectrum; in the red very strongly marked, the blue on the contrary faint, and strikingly short. In *Secchi's Cataloga di St.* (1867) there are two different announcements made with respect to the spectrum of γ *Eridanis*, both of them, however, differing from what I found.

2. LL. 3717; W. 947.
R. A. 1h. 53m. 14·9s. Decl. —9° 13′·7 (1855).
Star 6 mag., yellow reddish. Peculiarly well marked columns, pretty much like β *Geminorum*, and other similar stars. All the intervals sharp and dark; the star itself is perhaps variable within narrow limits.

Copenhagen: November, 1874. D'ARREST.

As in the first series, the magnitudes of the stars in the second series, as given by D'Arrest and as stated in the translations, differ in several instances.

		D'Arrest.		In translation.
1	...	7	...	6·8
2	...	6·7	...	6·2
3	...	?	...	5·0
4	...	6	...	5·0
5	...	8 "not brighter."		6·5
6	...	7·8	...	6·6
7	...	6·8	...	6·5
8	...	6	...	5·4
9	...	6	...	5·8
10	...	6·8	...	6·8
11	...	?	...	6·0
12	...	5	...	4·4
13	...	?	...	4·0
14	...	7	...	5·5
15	...	?	...	5·2
16	...	7	...	6·5
17	...	6	...	4·5
18	...	?	...	6·5
19	...	6	...	5·6
20	...	7·7	...	6·5
21	...	?	...	5·0
22	...	6	...	6·0
23	...	6	...	5·5
24	...	?	...	5·8
25	...	?	...	4·5
26	...	?	...	6·2

27	...	5·6	...	5·5
28	...	?	...	5·0
		Supplement.		
1	...	?	...	?
2	...	6 var. ?	...	?

(To be continued.)

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

FUNDAMENTAL POINT FOR LUNAR MEASURES.

Sir,—In the *Astronomical Register* for October, 1872, the question was raised as to which point near the centre of the moon was best adapted to serve as a fundamental point, or origin for lunar measures. This is a subject of considerable interest, for the completion of the triangulation of the moon's surface, commenced by Mädler in 1833, is the most urgent selenographical want. There is likewise another question in connection with which the selection of a fundamental point or origin of measures is a point of the highest importance, and this is one possessing an interest entirely apart from selenography, namely, the real libration of the moon due to the earth's attraction and the moon's ellipsoidal shape.

In a letter appearing in the *Astronomical Register* for January, 1873, a few observations made in October, 1872, in connection with this question, were given, and a promise of further when opportunity offered, and this communication is the redemption of that promise.

In the letter referred to the following points were mentioned, as suitable for the purpose, in so far as brightness and distinctness were concerned, viz., Mösting A, Murchison B, Murchison A, Ukert and Bode A, and observations as to their brightness and the duration of their shadows given.

Since the date of the letter referred to, the above list has been extended, and as far as mere distinctness is concerned, the following formations seem suitable for the purpose in view :

1. Mösting A. A 9° bright crater, 6 miles in diameter, and whose centre, according to Mädler, is in 3° 10′ S. lat. and 5° 15′ E. long.

2. Bode. A fine crater from six measures of Lohrmanns in 6° 37′ 54″ N. lat., and 2° 30′ 41″ E. long. It is circular in form, 9·3 miles in diameter, with a 4° bright interior, and 8° bright walls.

3. Bode B. A 7° bright small craterlet, sharply defined usually, and not to be confounded with any neighbouring formation. Its place according to Mädler is 8° 20′ N. lat., and 3° 0′ E. long.

4. Bode A. A brilliant deep craterlet, about 4 miles in diameter, and 8° to 8½° bright, being the most distinct point in this region. Its place according to Mädler is 8° 56′ N. lat. and —1° 16′ E. long.

5. Murchison A. A sharply marked fine crater, on the west border of the formation Murchison. It is Triesnecker A of Mädler who places it in 3° 57′ N. lat. and 1° 6′ W. long., and estimates its brightness at 7°. Its

present brightness much exceeds this, and is fully 8° bright, the formation occasionally rivalling in brilliancy even Mösting A, and must be then quite $8\frac{1}{2}$° bright. It is IA *a* 12 of the British Association map.

6. Ukert. A ring plain 14·1 miles in diameter, whose centre is in 7° 33′ N. lat., and 1° 26′ W. long., according to Mädler, who estimated its walls to be $7\frac{1}{2}$° bright, or more brilliant than the last. Its brightness now is only perhaps 7°.

7. Hipparchus E. A small crater north-west of Horrocks, and according to Mädler, who estimated its brightness as 7°, its place 2° 50′ S. lat., and 7° 2′ W. long. In the British Association map, founded on measures of photographs, it is placed far east, and somewhat north of this position. Mädler's estimate of its brilliancy scarcely holds, and $7\frac{1}{2}$° would be truer.

8. Hipparchus C. A fine crater, with 8° bright walls, and a 3° bright floor, according to Mädler, who places it in 7° 19′ S. lat., and 8° 18′ W. long. While its walls at times appears now to reach perhaps $8\frac{1}{2}$°, its floor is nearer 5° in brightness than 3°, and though from its small dimensions it is difficult to estimate the brightness of the interior 4° to $4\frac{1}{2}$° appears most probably correct. Though the 6° bright peaks of Hind and Halley, and 6° bright crater Hipparchus *l* are close, there is scarcely any need to fear that the crater C would be confounded with these, it standing out from the superior purity and brilliancy of its light perfectly distinct. The only other crater or point ever likely to be confused with it is the brilliant craterlet Hipparchus E, which stands in relation to Murchison A and Bode much in the same manner as Hipparchus C does to Mösting A and Lalande. To any one in any way familiar, with the region this mistake could not possibly occur.

The crater formation Triesnecker or Murchison B, has not been included, for though lying close to the centre of the moon's surface it is not well qualified for the purpose of an origin of measures.

Of the entire list of formation Mösting A is one of the most suitable, and its place having at the recommendation of Mädler and Bessel been adopted by the Wichmann as the fundamental point in his fine investigation of the real libration of the moon, its claims cannot be overlooked. From 50 measures Wichmann determined the position of this point to be 3° 10′ 55″ S. lat., and 5° 13′ 23″ E. long., and this position has been confirmed by a number of new measures made by myself. As for a new investigation of the real libration of the moon, this point must be brought into the scope of the measures, it must always be considered one of the principal points on the moon.

The 3rd and 4th on the list, Bode B and A, are well suited to be a second point, though perhaps somewhat too far north, yet their sharpness and distinctness is a recommendation of moment. They have been therefore carefully measured and their positions determined to be as follows :—

Bode B, 6 measures, 8° 42′ 40″ N. lat. 3° 9′ 41″ E. long.

Bode A, 6 measures, 8° 53′ 57″ N. lat. 1° 19′ 40″ E. long.

The position of the first agrees fairly well with that found by Mädler, though further north, whilst the position of the second shows Mädler's result to have been very accurate.

Ukert, 6th on the list is too large to be adopted, though it must be borne in mind that a very small formation is not so suitable as one of from three to five miles in diameter. The position of the centre of the interior has been determined from a series of measures to be as under :—

Ukert. 11 measures, 7° 48′ 24″ N. lat., 1° 9′ 10″ W. long. Mädler therefore places this formation too far south-west by fully fifteen minutes, or some four seconds of arc.

The 7th on the list, Hipparchus E, though very well suited in itself to

be a standard point, and well individualised, is not well placed in regard to other points, which, together with Mösting A, should serve as a basis for future work. It has therefore not been made a point of the first order like the previous formation but four measures of the second order give 4° 0′ S. lat. and 6° 1′ W. long.

There remains, therefore, the three points—Bode, Murchison A, and Hipparchus C to consider. The last two of these in conjunction with Mösting A, form nearly an equilateral triangle with the moon's mean centre in the middle, and are exceedingly well placed for an investigation of the real libration of the moon. These three formations, all over 8° bright, perfectly distinct and sharply defined, are the best system of fundamental points upon the moon, and have, therefore, been adopted by myself as such. These positions have been determined with care, and are more accurate, probably, than any point of the first order in the triangulation of Mädler, and only surpassed by Manilius, Mösting A, and perhaps, Bode.

Murchison A.		18 Measures.	
Latitude N.	= 4° 3′ 57″	Prob. error = 1′ 56″	= 0·″53 of arc.
Longitude W.	= 1° 0′ 4″	Prob. error = 2′ 33″	= 0·″69 of arc.
Hipparchus C.		18 Measures.	
Latitude S.	= 7° 22′ 57″	Prob. error = 3′ 36″	= 0·″96 of arc.
Longitude W.	= 8° 3′ 34″	Prob. error = 1′ 34″	= 0·″42 of arc.

These two results agree well with Mädler's results as points of the second order which, as mentioned, are for Murchison A. N. lat., 3° 57′. W. long., 1° 6′, and Hipparchus C, S. lat., = 7° 19′ and W long. 8° 18′; the only difference being Mädler placing the longitude of the last some 15′ too far west; an error as shown by Birt, and since confirmed by myself, common to nearly all his positions of the second order in this region.

The position of Mösting A according to Wichmann 50 measures, is

S. Latitude	= 3° 10′ 55″	Prob. error 24″
E. Longitude	= 5° 13′ 23″	Prob. error 1′ 30″

The probable error of a single observation of Wichmann is a little less than those of my own, but both markedly less than those of Mädler, the difference being directly as the superiority of the instrument employed.

Bode, the last point to be considered, though not one of the triangle, will yet be found very important if employed as an auxiliary point, being exceedingly well placed to connect any new investigation into the lunar co-ordinates, with the previous ones of Bouvard and Nicollet, and Wichmann. It will be indispensable, therefore, to bring it within the grasp of any future work of this nature. Its position has been determined with considerable care and a series of twenty-eight new measures made by myself. Uniting these with the six due to Lohrmann, and the result is as follows:—

Bode.		34 Measures.	
N. Latitude	= 6° 37′ 55″	Prob error 1′ 48″	= 0·″46 in arc.
E. Longitude	= 2° 37′ 51″	Prob. error 1′ 49″	= 0·″46 in arc.

This result confirms with considerable exactitude the previous result obtained by Lohrmann, the latitudes agreeing exactly, and the difference of some eight minutes in longitude being within the probable error of Lohrmann's result.

Bode is, therefore, after Manilius and Mösting A, the best determined point on the entire moon, and one that with an adequate power, about 250, very easily and accurately measured, separate results on the same day agreeing usually within one second of arc. The dark interior,

about four seconds in diameter, enabling the exact bi-section by the micrometer wire to be determined with exactness.

The result therefore of my observations indicates that the triangle formed by Mösting A, Hipparchus C, and Murchison A is the best adapted for the purpose of ascertaining the exact position of the mean centre of the moon's surface; to serve as standard points, or point to serve as origin of measures; and to serve as the basis of a properly elaborate investigation of the real liberation of the moon. Further, that Bode, which is well suited to serve as a standard point, will prove the point best adapted to act as a link between any new investigation of the real libration of the moon and the earlier researches. The advantages gained by employing a system of three points rather than one cannot be detailed now, but are considerable.

Yours faithfully,

E. NEISON.

MOON.

On November 11 and 12 possessors of telescopes may again have the chance of observing those apparent depressions of the moon's rim, which gave occasion for Mr. Key's rather startling diagram in the 24th volume of the *Monthly Notices*, and to the recurring visibility of which, in October, attention was called on page 247 of the *Astronomical Register*. The circumstances on November 12 will be favourable for testing directly the correctness of the diagram, the preceding limb, where the depressions were seen, being still fully illuminated.

A. MARTH.

CAPELLA.

Sir,—Cannot most of the varying colours of Capella, given in your September number, p. 215, be accounted for by its comparatively low altitude when most of the observations were made? I do not know what are the "conditions laid down by Dr. Argelander in his well-known article," to which Mr. Ellner says he paid due attention; but it is evident that most of his observations were made when Capella was low enough to show those flashes of different colours which stars always exhibit when they twinkle strongly. Under such circumstances it would be impossible to tell its true colour. To me the colour of Capella, when the true colour has been visible, has always appeared just the same; but then my observations do not date so far back as 1855.

ι ANDROMEDÆ.

This star, about which G. F. Chambers enquires on p. 221, is recorded by Ptolemy and Argelander of the 4th magnitude, and by Sûfi as a bright 4th: by all as equal to κ and λ. It is still exactly equal to κ.

I am, yours truly,

West Hendon House, T. W. BACKHOUSE.

Sunderland: Oct. 9, 1875.

THE NOVEMBER METEORS.

Sir,—I am not sufficiently acquainted with the history of the November shower of meteors to know whether attention has been called to the

following observation. It occurs among some astronomical observations of Dawer, in Mem. Roy. Astro. Soc. viii. 76.—"1832·865. Most astonishingly brilliant meteors, from the east, with little intermission for about an hour, when a thick fog supervened." The epoch here given corresponds (1832 having been leap-year) with November 12, at noon: unfortunately, not having access to the original, I can say nothing as to the hour, but I suspect it is not specified.

I remain, yours faithfully,

Sept. 29, 1875. T. W. WEBB.

PARALLAX OF TWENTY STARS.

Sir,—In the first edition of Chambers' *Handbook of Astronomy*, 1861 it is stated, at page 272, that "The actual distances of nine stars have been carefully and satisfactorily ascertained within the last few years." I have not at hand the second edition of Mr. Chambers' compilation, and am consequently not in a position to say of how many stars he therein states the distance to be known. Thinking, however, that it may interest some of the readers of the *Astronomical Register*, I send you herewith a list of twenty stars of which the parallax has been ascertained, and whose distance, therefore, may be calculated. I take the list from an article by Dr. Hermann J. Klein, published during the present year, in the *Vierteljahres-Revue der Naturwissenschaften.* This article, containing an account of the progress of astronomy in 1873-1874, is also issued in the form of a separate pamphlet; a similar pamphlet is likewise to be had for the like progress in 1870-1872. The publisher is E. H. Mayer, Cologne and Leipzig. The title of the pamphlets is *Die Fortschritte auf dem Gebiete der Astronomie*, 1870-1872; and 1873-1874.

I remain, yours faithfully,

Oct. 1, 1875. A.B.

Name of Star.	Parallax. ″		Distance in semidiameters of Earth's Orbit.
α Centauri	0,919	...	224000
61 Cygni	0,511	...	404000
21185 Lalande	0,501	...	412000
β Centauri	0,496	...	416000
η Cassiopeæ	0,371	...	556000
34 Groombridge	0,307	...	672000
21258 Lalande	0,260	...	793000
7515 Oeltzen	0,247	...	835000
σ Draconis	0,246	...	838000
α Canis majoris	0,193	...	1067000
α Lyræ	0,180	...	1146000
70 p. Ophiuchi	0,162	...	1272000
ι Ursæ majoris	0,133	...	1551000
α Bootis	0,127	...	1624000
1830 Groombridge	0,118	...	1748000
γ Draconis	0,092	...	2292000
α Ursæ minoris	0,076	...	2714000
3077 Bradley	0,055	...	3500000
85 Pegasi	0,054	...	3500000
α Aurigæ	0,046	...	4500000

THE DECLINE AND FALL OF THE BRITISH ASSOCIATION.

Sir,—Of all the causes indicated in your very admirable leading article in this month's *Astronomical Register*, as operating in the production of the only too evident decay of the British Association for the Advancement of Science, undoubtedly one of the most potent is that stigma of cliquism, which you refer to apparently only to discredit, but which, unhappily, has only too much foundation in fact.

Anything, for example, more impudent and insulting to disinterested men of science than Professor Balfour Stewart's address in section A this year, was probably never listened to. It was a direct and deliberate insidious attempt to bolster up that abominable job, the Observatory for Solar Physics, and to lend the weight of the speaker's name (*quantum valeat*) to the recommendation, hereafter to be made, that his private personal friend, Mr. Joseph Norman Lockyer, should be installed in a costly sinecure at the national expense. If any evidence of this were needed it would be found in the fact that the moment Mr. Stewart sat down Colonel Strange got up to express his opinion that the address "was one of the most admirable they had ever had in that section." Taking this in connection with the way in which Colonel Strange thrust himself forward in the matter of the Royal Commission on the Advancement of Science, an impartial and unprejudiced outsider can come to but one conclusion.

And this suggests the idea that it is the preponderance of people of the gallant Colonel's scientific calibre in the British Association which is causing our leading philosophers to hold aloof from it. Every one knows how easy it is, if you are in a certain set, to get into a dozen of the learned societies if you choose, and can only afford to pay the needful subscriptions, and our chief *savants* will not travel some hundreds of miles to hear comparative scientific nobodies pay one another fulsome compliments for an ulterior end.

Unless our real leaders in science will take the matter up *con amore*, and (displacing the merely fussy and impudent clique who have been gradually been getting into power and authority) substitute science for self-seeking, the days of the British Association are numbered.

October 16, 1875. I am, Sir, yours truly,

A QUONDAM MEMBER OF SECTION A.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN NOVEMBER, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zones XXIX. to XXXV. British Association map, 70° to 90° N. latitude, region around the North Pole.

In 30° W. longitude the west border of the north part of Meton (41) in latitude 70° to 75° N. North of Meton, Euchemon (42) in latitude 75° to 80° N.: the west border of Euchemon is in 40° west longitude. On the west of Euchemon is a large unnamed formation; a drawing of Euchemon and of his formation (which must be of great extent, as it appears to us considerably foreshortened on account of its proximity to the moon's limb) will be found in B. and M.'s Beiträge Tafels I., and a description in article V. page 63, on the Region about the North Pole. The name of Zollner (499) is proposed for this formation. Between the tenth and first meridians of west longitude and 75° and 80°

of north latitude Barrow (45). North of Barrow, between 10° and 15° west longitude and 75° and 80° north latitude, Scoresby (43), north-east of which are Challis (435) and Main (436). Main is situated in Zone XXXIII. between 80° and 85° north latitude. On the northern edge of Zone XXXIII. and cut by the first meridian is Gioja (44) the south part, the north part is in Zone XXXV; this crater is the nearest to the north pole, see the drawing already referred to in the Beiträge of B. and M. In Zone XXIX. latitude 70° to 75° N. and between 2° W. longitude and 8° E. longitude is the fine formation Goldschmidt (427) having the ray centre Anaxagoras (168) to the east of it. The only crater further to the east in this Zone, and indeed north of 70° and east of the first meridian is Philolaus, see note (*d*) in the list for September *ante* p. 225. The drawing in B. and M.'s Beiträge contains Euchemon, *Zollner*, Scoresby, Challis, Main (marked *b* and *c*), and Gioja; also the description contains the determination of the position of five points of the first order, four of which are beyond the pole. In order to see these objects as well as the pole advantageously it is necessary that the moon should have great south longitude.

Erratum.—In the list for October, p. 248, for *N.* latitude read *S.* latitude.

THE PLANETS FOR NOVEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	14 1 59	S. 12 54	9″·6	23 16·7
	9th	13 53 54	S. 9 22	7″·6	22 37·2
	17th	14 20 43	S. 11 40½	6″·2	22 32·5
	25th	15 3 11	S. 15 42	5″·7	22 43·4
Venus ...	1st	15 5 52	S. 17 7½	10″·0	0 24·3
	9th	15 46 30	S. 19 55	10″·0	0 33·4
	17th	16 28 25	S. 22 7	10″·2	0 43·7
	25th	17 11 27	S. 23 38½	10″·2	0 55·2
Mars ...	1st	20 35 15	S. 20 51½	10″·8	5 52·8
	9th	10 57 30	S. 19 11½	10″·4	5 43·6
	17th	11 19 41	S. 17 21½	9″·8	5 34·2
	25th	21 41 42	S. 15 23	9″·4	5 24·7
Saturn ...	1st	21 29 21	S. 16 18	15″·8	6 46·8
	9th	21 30 1	S. 17 14	15″·4	6 16·0
	17th	21 31 5	S. 16 8	15″·2	5 45·6
	25th	21 32 34	S. 16 0	15″·0	5 15·6
Neptune ...	1st	1 58 42	N. 10 16½	...	11 16·3
	17th	1 58 5	N. 10 8	...	10 11·8

Mercury will be well situated for observation in the middle of the month, rising nearly an hour and a half before the sun on the 6th, the interval increasing to about two hours before the sun on the 17th, from which date the interval gradually decreases.

Venus sets about an hour after the sun on the 1st, the interval increasing to two hours on the last day.

Mars may still be observed in the evening, setting about two hours before midnight on the 1st, the interval slightly increasing.

Saturn sets half an hour before midnight on the 1st, the interval increasing.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc. °	°	Heliographical lat. of the centre of the sun's disc. °	Angle of position of sun's axis. °	
Nov. 1	41·11	+13·20	+4·19	24·64	—·17
2	54·31	·20	4·08	24·47	·19
3	67·51	.20	3·97	24·28	·19
4	80·71	·20	3·87	24·09	·20
5	93·91	·20	3·76	23·89	·20
6	107·11	·20	3·65	23·69	·22
—					
7	120·31	·20	+3·54	23·47	—·22
8	133·51	·20	3·43	23·25	·23
9	146·71	·20	3·32	23·02	·24
10	159·91	·19	3·20	22·78	·24
11	173·10	·20	3·09	22·54	·26
12	186·30	·20	2·97	22·28	·26
13	199·50	·20	2·86	22·02	·27
—					
14	212·70	13·20	2·74	21·75	—·27
15	225·90	·20	+2·62	21·48	·28
16	239·10	·19	2·50	21·20	·29
17	252·29	·20	2·38	20·91	·30
18	265.49	·20	2·26	20·61	·31
19	278·69	·20	2·14	20.30	·31
20	291·89	·19	2·02	19·99	·32
—					
21	305·08	13·20	+ 1·90	19·67	—·33
22	318·28	·19	1·77	19·34	·34
23	331·47	·20	1·65	19·00	·34
24	334·67	·19	1·52	18·66	·35
25	357·86	·20	1·40	18·31	·35
26	11.06	·19	1·27	17·96	·36
27	24·25	·20	1·15	17·60	·37
—					
28	37·45	13·19	+ 1·02	17·23	—·37
29	50·64	·19	0·89	16·86	·38
30	63·83	·20	0·77	16·48	·39
Dec. 1	77·03		0·64	16·09	

A. M.

DISCOVERY OF A MINOR PLANET.

The following telegram has been received from Professor Henry, Washington :—"Planet by Wibon (?). R. A., 1h. 0m. Decl., 6° 54′ N. Tenth (magnitude). Daily motion south, five (minutes)."

Errata.—Oct. No., page 244, line 15 from bottom, for *the sun, and the planets*, read *the sun the planets*. Page 246, line 22, for *Avacte* read *Aracte*.

ASTRONOMICAL OCCURRENCES FOR NOVEMBER, 1875.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Mon	1		Sidereal Time at Mean Noon, 14h. 41m. 28·07s.	The Satellites of Jupiter are invisible through his nearness to the Sun.		Saturn 6 46·8
Tues	2	—	Sun's Meridian Passage 16m. 19·20s. before Mean Noon		—	6 42·9
Wed	3	—			—	6 39·0
Thur	4	10	Conjunction of Sun and Jupiter		—	Moon. — 4 47·4
Fri	5	21 52 11	☽ Moon's First Quarter Conjunction of Moon and Mars 2° 36′ N.		—	5 37·1
Sat	6	8 4 8	Near approach of ι Capricorni (4½) Conjunction of Moon and Saturn, 2° 42′ N.		—	6 25·0
Sun	7	11 7 11 36	Occultation of B.A.C. 7835 (6½) Reappearance of ditto		—	7 11·3
Mon	8	9 31 9 56	Occultation of χ Aquarii (5½) Reappearance of ditto		—	7 57·0
Tues	9	10 10	Near approach of B.A.C. 8365 (6½)		—	8 42·9
Wed	10	11 44 12 49	Occultation of B.A.C. 274 (6) Reappearance of ditto		—	9 30·5
Thur	11				—	10 21·1
Fri	12	21 49 0 5	○ Full Moon Saturn in quadrature with Sun Uranus in quadrature with Sun		—	11 16·3
Sat	13				—	12 16·7
Sun	14	—	Sun's Meridian Passage 13m. 28·16s. before Mean Noon		—	α Pegasi — 7 24·6
Mon	15	 5 25 6 10	Illuminated portion of disc of Venus=0·974 Illuminated portion of disc of Mars=0·856 Occultation of 136 Tauri (4) Reappearance of ditto			7 20·7

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. α Pegasi
Tues	16	9 4 9 54	Occultation of 47 Geminorum (6) Reappearance of ditto			7 16·8
Wed	17	 11 25 12 25 6	Saturn's Ring: Major axis=38"·05 Minor axis=9"·21 Occultation of λ Cancri (6) Reappearance of ditto Conjunction of Mars and ι Capricorni (4·3m.) W.	The Satellites of Jupiter are invisible through his nearness to the Sun.		7 12·8
Thur	18		Sidereal Time at Mean Noon 15h. 48m. 29·53s.			7 8·9
Fri	19	12 37 14 37 15 46	☾ Moon's Last Quarter Occultation of 37 Leonis (6) Reappearance of ditto			7 4·9
Sat	20	15 39	Near approach of χ Leonis (5)			7 1·1
Sun	21	14 49 15 53 16	Occultation of β Virginis (3½) Reappearance of ditto Conjunction Saturn and Mars, 0° 13′ S.			6 57·1
Mon	22					6 53·2
Tues	23	19 25 20 37	Occultation of α Virginis (1) Reappearance of ditto			6 49·2
Wed	24	23	Conjunction of Jupiter and Mercury 0° 44′ N.			6 45·3
Thur	25					6 41·4
Fri	26	1 4	Conjunction of Moon and Jupiter, 4° 27′ N. Conjunction of Moon and Mercury 5° 8′ N.			6 37·4
Sat	27	11 44	● New Moon			6 33·5
Sun	28	17	Conjunction of Mars and ι Aquarii (8·5m.) E.			6 29·6
Mon	29	2	Conjunction of Moon and Venus 4° 8′ N.			6 25·6
Tues	30	0	Conjunction of Mars and μ Capricorni (8·2m.) W.			6 21·7
DEC. Wed	1					6 19·8

EPHEMERIS OF THE SATELLITES OF SATURN.

The rectangular co-ordinates of the three inner satellites and the apparent distances of Titan and Iapetus, are expressed in semi-diameters of the planet's equator.—" pos."=angle of position.

+ x East of minor axis of ring. + y North of major axis of ring.
— x West „ „ „ — y South „ „ „

At 20h. Greenwich Sidereal Time.

1875.	Tethys.		Dione.		Rhea.		Titan.		Iapetus.	
Nov.	x	y	x	y	x	y	pos.	dist.	pos.	dist.
1	—2·9	+1·0	—3·8	+1·3	—8·2	—0·9	107·4	16·9	81·2	15·4
2	+2·2	—1·1	+6·4	—0·1	—4·9	+1·8	119·2	11·6	83·5	19·9
3	—1·3	+1·2	—4·6	—1·1	+6·4	+1·5	154·0	6·0	85·0	24·4
4	+0·5	—1·2	—0·3	+1·6	+7·3	—1·3	229·4	6·8	85·9	28·7
5	+0·4	+1·2	+5·0	—1·0	—3·7	—2·0	257·0	12·6	86·7	32·9
6	—1·3	—1·2	—6·3	—0·3	—8·7	+0·5	267·4	17·5	87·3	36·8
7	+2·1	+1·1	+3·2	+1·4	+0·6	+2·2	273·9	20·1	87·8	40·5
8	—2·9	—1·0	+2·0	—1·5	+8·9	+0·3	279·6	19·8	88·2	43·9
9	+3·6	+0·9	—5·9	+0·6	+2.7	—2·1	286·6	16·4	88·5	47·0
10	—4·1	—0·7	+5·7	+0·7	—7·9	—1·0	299·5	10·8	88·8	49·8
11	+4·5	+0·5	—1·6	—1·5	—5·6	+1·7	343·9	5·2	89·0	52·3
12	—4·8	—0·3	—3·6	+1·3	+5·8	+1·6	59·5	7·8	89·3	54·4
13	+5·0	+0·1	+6·3	—0·2	+7·7	—1·1	80·8	14·0	89·5	56·1
14	—5·0	+0·1	—4·8	—1·0	—3·0	—2·0	89·5	18·7	89.7	57·5
15	+4·8	—0·3	—0·1	+1·5	—8·8	+0·3	95·3	20·9	89·9	58·5
16	—4·5	+0·5	+4·9	—1·0	—0·2	+2·2	100·6	20·3	90·1	59·1
17	+4·0	—0·7	—6·3	—0·2	+8·7	+0·4	107·2	17·0	90·3	59·4
18	—3·4	+0·9	+3·5	+1·3	+3·4	—2·0	118·7	11·6	90·4	59·3
19	+2·7	—1·0	+1·8	—1·5	—7·5	—1·2	152·8	6·0	90·6	58·8
20	—2·0	+1·1	—5·8	+0·7	—6·2	+1·6	229·2	6·7	90·8	57·9
21	+1·1	—1·2	+5.8	+0·6	+5·2	+1·7	257·1	12·5	91·0	56·7
22	—0·3	+1·2	—1·9	—1·5	+8·1	—0·9	266·4	17·5	91·1	55·1
23	—0·6	—1.2	—3·4	+1·3	—2·3	—2·1	273·8	20·1	91·3	53·2
24	+1·5	+1·1	+6·3	—0·3	—8·9	+0·1	279·4	19·8	91·5	50·9
25	—2·3	—1·1	—4·9	—1·0	—1·0	+2·1	286·2	16·5	91·8	48·3
26	+3·0	+0·9	+0·2	+1·5	+8·5	+0·6	298·7	10·8	92·0	45·5
27	—3·7	—0·8	+4·7	—1·0	+4·2	—1·9	341·8	5·2	92·3	42·3
28	+4·2	+0·6	—6·4	—0·2	—7·0	—1·3	59·3	7·6	92·6	39·0
29	—4·6	—0·5	+3·7	+1·2	—6·7	+1·4	80·9	13·8	93·0	35·4
30	+4·9	+0·2	+1·5	—1·5	+4·5	+1·8	89·5	18·6	93·5	31·6
Dec. 1	—5·0	0·0	—5·7	+0·7	+8·4	—0·7	95·1	20·9	94·1	27·6

Approximate times of the conjunctions of the satellites with the centre of the planet, or of their passing in the direction of the minor axis of the ring.

Gr. Sid. Time.	h.		y	Gr. Sid. Time.	h.		y
Nov. 1	22·2	Encel.	—1·0		6·1	Rhea	+2·2
	0·5	Tethys	+1·2		7·2	Encel.	—1·0
	2·7	Dione	+1·6		11·6	Dione	—1·6
	14·7	Encel.	+1·0	3	21·9	Tethys	+1·2
2	23·2	Tethys	—1·2		23·7	Encel.	+1·0

Gr. Sid. Time.	h.		y
	6.0	Titan	−5.1
4	16.2	Encel.	−1.0
	20.6	Dione	+1.6
	20.7	Tethys	−1.2
	8.6	Encel.	+1.0
	12.5	Rhea	−2.2
5	19.4	Tethys	+1.2
	1.1	Encel.	−1.0
	5.5	Dione	−1.6
6	17.6	Encel.	+1.0
	18.1	Tethys	−1.2
	10.1	Encel.	−1.0
	14.5	Dione	+1.6
7	16.8	Tethys	+1.2
	18.9	Rhea	+2.2
	2.6	Encel.	+1.0
8	15.5	Tethys	−1.2
	19.1	Encel.	−1.0
	23.4	Dione	−1.6
	11.6	Encel.	+1.0
	14.3	Tethys	+1.2
9	1.3	Rhea	−2.2
	4.1	Encel.	−1.0
	8.3	Dione	+1.6
	13.0	Tethys	−1.2
10	20.6	Encel.	+1.0
	11.7	Tethys	+1.2
	13.1	Encel.	−1.0
11	17.3	Dione	−1.6
	2.0	Titan	+4.8
	5.6	Encel.	+1.0
	7.6	Rhea	+2.2
	10.4	Tethys	−1.2
12	22.0	Encel.	−1.0
	2.2	Dione	+1.6
	9.1	Tethys	+1.2
	14.5	Encel.	+1.0
13	7.0	Encel.	−1.0
	7.9	Tethys	−1.2
	11.2	Dione	−1.6
	14.0	Rhea	−2.2
14	23.5	Encel.	+1.0
	6.6	Tethys	+1.2
15	16.0	Encel.	−1.0
	20.1	Dione	+1.6
	5.3	Tethys	−1.2
	8.5	Encel.	+1.0
16	20.4	Rhea	+2.2
	1.0	Encel.	−1.0
	4.0	Tethys	+1.2
	5.1	Dione	−1.5
17	17.5	Encel.	+1.0
	2.8	Tethys	−1.2
	10.0	Encel.	−1.0
	14.0	Dione	+1.5

Gr. Sid. Time.	h.		y
18	1.5	Tethys	+1.2
	2.5	Encel.	+1.0
	2.8	Rhea	−2.2
19	19.0	Encel.	−1.0
	23.0	Dione	−1.5
	0.2	Tethys	−1.2
	6.3	Titan	−5.0
	11.5	Encel.	+1.0
20	22.9	Tethys	+1.2
	3.9	Encel.	−1.0
	7.9	Dione	+1.5
	9.2	Rhea	+2.2
21	20.4	Encel.	+1.0
	21.7	Tethys	−1.2
	12.9	Encel.	−1.0
22	16.8	Dione	−1.5
	20.4	Tethys	+1.2
	5.4	Encel.	+1.0
	15.6	Rhea	−2.1
23	19.1	Tethys	−1.2
	21.9	Encel.	−1.0
	1.8	Dione	+1.5
	14.4	Encel.	+1.0
24	17.8	Tethys	+1.2
	6.9	Encel.	−1.0
	10.7	Dione	−1.5
25	16.5	Tethys	−1.2
	22.0	Rhea	+2.1
	23.4	Encel.	+1.0
	15.3	Tethys	+1.2
	15.9	Encel.	−1.0
26	19.7	Dione	+1.5
	8.4	Encel.	+1.0
	14.0	Tethys	−1.2
27	0.9	Encel.	−1.0
	2.5	Titan	+4.7
	4.4	Rhea	−2.1
	4.6	Dione	−1.5
	12.7	Tethys	+1.2
28	17.4	Encel.	+1.0
	9.9	Encel.	−0.1
	11.4	Tethys	−1.2
	13.6	Dione	+1.5
29	2.3	Encel.	+1.0
	10.2	Tethys	+1.2
	10.8	Rhea	+2.1
30	18.8	Encel.	−1.0
	22.5	Dione	−1.5
	8.9	Tethys	−1.2
	11.3	Encel.	+1.0
Dec. 1	3.8	Encel.	−1.0
	7.5	Dione	+1.5
	7.6	Tethys	+1.2

A. MARTH.

THE SIZE OF THE SUN.

If the recent corrections of the sun's distance are ultimately established by the transit observations of 1874, this will really indicate that the sun itself is a spheroid 850,000 miles across, and that in mere matter of bulk it is so vast that a million and a quarter of earths would barely suffice to make up its volume. A much more satisfactory and philosophic conception of the "Home Rule" of the universe is secured, if a start is made in idea from this grand centre standpoint, rather than, in accordance with the more usual practice, from the earth. The source of activity and power is an orb, nearly one millions of miles across, and the pigmy earth which is dependent upon that source for light, warmth, life, and all change and movement of whatever kind, is suspended in space one hundred and eight diameters of that central orb away, and is of one million and a quarter times smaller dimensions than the sphere from which it receives those endowments. There is, certainly, more for the human intellect to seize when the fact is stated in this way than there is when the sun is spoken of as a sphere ninety-two millions of miles from the earth, and as large again as the moon's orbit. It is a suggestive and noteworthy feature in the economy of nature that in the one instance which comes within the personal experience of man, the great central fountain and source of impulse, energy, and power is six hundred times larger than the entire cluster of subordinate worlds that are lit, warmed, and organised from that source. Such in the marvellous scheme is the ratio of power to result, of active determining cause to passive accomplishment—six hundredfold to one! Fire-eddies thousands of miles across, and flame-tongues one hundred thousand miles high, whirl and leap in the sun in order that soft winds may breathe, gentle rains fall, verdant plants grow, and endless generations of animals succeed each other and run through the appointed round of sentient being, on the islet worlds that have been scattered through space, each at the appropriate span of remoteness that fits it to the end secured.—"The Approaching Transit of Venus." *Edinburgh Review*, July, 1873, pp. 157–8.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1875.	To Dec., 1875.
Lancaster, J. L.	Hubbersty, Rev. R. C.
Lancaster, W. L.	Sargent, Rev. J. P.

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When subscriptions sent by post are not acknowledged in the next number, the Editor will be much obliged if subscribers will *at once* inform him of the fact.

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The pages of the *Astronomical Register* are open to all suitable communications, Letters, Articles for insertion, &c., must be sent to the Rev. J. C. JACKSON, *Clarence Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 156. DECEMBER. 1875.

ROYAL ASTRONOMICAL SOCIETY.

Session 1875—76.

First Meeting after the Long Vacation, November 12th, 1875.

Professor Adams, F.R.S., *President*, in the Chair.

Secretaries—Mr. Dunkin and Mr. Ranyard.

John Brise Colgrove, Esq., M.A., Head Master of the Modern Side Rossall School,

was balloted for and duly elected a Fellow of the Society.

The minutes of the last meeting were read and confirmed.

Mr. Ranyard announced that 114 presents had been received since the last meeting in June, and the thanks of the Society were voted to the donors.

The President drew attention to the fact that amongst the presents was a very valuable series of photographs which had been given to the Society by Mrs. Selwyn, the widow of the late Canon Selwyn. It was probably known to most of the Fellows of the Society that the late Canon had for many years had daily photographs of the sun taken, which he in his happy way called solar autographs. The series, which was now in accordance wsth his wishes, presented to the Society, comprised a period of eleven years, and corresponded with a complete sun-spot cycle. The photographs, a packet of which was laid on the table, were packed together in order of date, so that they could be easily referred to. The Council had at their afternoon meeting the pleasure of returning the cordial thanks of the Society to Mrs. Selwyn for this very valuable present.

The Astronomer-Royal asked whether there was any mark upon the photographs by which the north point could be distinguished.

Professor Adams said it certainly had been attended to in the

case of the latter ones. He then called upon the Astronomer-Royal to make a communication to the Society, and in so doing he took occasion to congratulate him on the part of the Society on the freedom of the City, which he had recently received.

Mr. De la Rue requested the Astronomer-Royal to give the Society ocular demonstration of the honour which had been conferred upon him.

The casket containing the freedom was then placed upon the table. It appeared to be a golden box some six inches long, and three high, surmounted by the arms of the City of London, and ornamented with stars, telescopes, and other astronomical devices. Within the box was a roll of parchment about the size of a cigar, on which the freedom of the City was engrossed in illuminated characters.

The Astronomer-Royal, who on rising begged to remind the meeting that he was not only a "freeman" but a "spectacle-maker," of tle City of London, said that after the recess he thought that it would not be improper to state the general course of things that had been going forward at the Royal Observatory at Greenwich. In the ordinary course of their work, they were just commencing to prepare a new star-catalogue, including the results of observations for eight years, if they terminated now, though they might carry it to nine years, but that had not yet been determined. He was proud to say the star-catalogues which had been issued from time to time had been considered valuable by those who had occasion to refer to the places of the stars. There was a point he desired to mention as of much importance to all persons who used the same instruments for any great length of time. They were struck in a very melancholy way at the Observatory by the fact that their micrometers were failing. To him it was perfectly new that a micrometer-screw should ever wear out, but it was assuredly the case, and he had been very much harassed by it. It was first pointed out to him by Mr. Christie, who in paying close attention to the results of observations, was led to the conclusion that something had gone wrong with the microscope-micrometers of the transit-circle, and it was suggested by Mr. Simms that the threads of the screws had worn sufficiently to account for the discrepancy. On a calculation he (the Astronomer-Royal) found that it was not unlikely that the screws had been used 100,000 times, and it was very conceivable they might have suffered in that time. Happily they had something to which they could refer. In the original construction of the transit circle, they had provided four micrometers for the purpose of examining the graduations of the circle, and rendering themselves absolutely independent of the scale of the

instrument-maker and the excellence of his dividing engine. They were enabled, therefore, to use collaterally the four microscopes which had been very little used, and might be considered as good as new, and they established the proof of the wearing beyond doubt. It was clear that the micrometer-microscopes upon which they had relied so long had gone sensibly wrong. They were now endeavouring to set the fault right, and he mentioned the matter as a warning not totrust to micrometer-screws too long.

Beyond the ordinary course of observations, Mr. Christie was engaged in a series of observations of the satellites of Saturn. He mentioned this not so much on account of its own importance as of the importance of the course which had led to it. These observations had been suggested and had been made practicable by the ephemerides that Mr. Marth had published in the *Astronomische Nachrichten.* He desired to enforce on all who were interested in any particular department of observation that the thing to be done in every case where they thought they had made out a law, was to publish the order of events to be observed, and leave the old class astronomers at the Observatory the task of following it out. For example, many persons had speculated on the changes in the clouds and spots on the surface of Jupiter, It seemed to him that there was no more use in making observations of Jupiter at this time and that time than in noting the difference of clouds on a summer's day, but what they wanted was observations of the same clouds or spots, and this could be easily got at, for the rotation of Jupiter is pretty well known. If any one would give an ephemeris of the days and hours at which any portion of Jupiter which they thought to be specially worthy of study would come into view, those at the Observatory would take it up and try and make it useful.

The next thing he had to touch upon was the progress made at the Observatory in solar photography. They had endeavoured to do the best in their power, and that with considerable regularity. In one respect it had been a very thankless task, for there were fewer spots on the sun now than he could ever remember, and in some cases the results of the observations had been nil, but they were still carrying them out, and in deference to the authority of Mr. De la Rue, whom he looked upon as their forerunner in the science, they would endeavour to follow his methods, and consult with him on any change as far as possible.

The next matter that had engaged their attention in a considerable degree was spectroscopy. Mr. Huggins had pointed out that from these observations something might be inferred as to the approach or receding of stars, and upon this important question

a good number of observations have been collected, and a paper had been prepared on them. He was bound to say they were rather queer observations at first, though later on they had grown more consistent. The difficulties they had to encounter could not be conceived by any one unacquainted with the spectroscope and all its subordinate parts. He wished that Mr. Lassell, who had given so much attention to the curvature of surfaces, would tell them how to get a plane surface; it appeared to him to be the most difficult problem you could present to the mechanical genius of man. (Laughter.) In most points the results of the observations agreed in the main with those of Mr. Huggins. Mr. Huggins would, he felt sure, not think they had done wrong in revising what he had done. It was his privilege to start a science and it was theirs to revise it. (Hear, hear.) In time they hoped to produce results which would do honour to his invention. He would warn all who would follow up this matter, whether with respect to stars or the protuberances on the sun, that they would have to face plenty of expense and trouble.

The next remark he would make was that the work at the Observatory connected with the transit of Venus was a very heavy one, and would be so for a long time to come. The difficulty was not with the observations of the transit itself, but rather with the observations immediately connected with them, and the corrections of the instruments, but when that had been done the rest would be easy.

The Society would be aware that in a paper he presented to it many years ago he pointed out that he should prefer observations of Mars in 1877, to observations of the transit of Venus, for, provided they had equatorials of sufficient firmness (for that was the grand desideratum) in different places, it would be in the power of almost any observer, and more especially of those near the equator, to determine the parallax of the sun, probably better than by any other method. In endeavouring to carry this out they had prepared at the Observatory a chart of the path of Mars and all the stars in its neighbourhood during the opposition of 1877, which he trusted the Society would allow to be published in the *Monthly Notices*.

There was another subject which had occupied him and his assistants very much, and that was the lunar theory in the shape in which he had propounded it to the Society some time ago. He hoped to prepare a paper on this with details shortly. The lunar theory was a work imposing an enormous amount of calculation. There were points upon which his own personal attention was now required—one was the terms of long period and the terms which rise slowly. This would be readily understood when he

said that the process they adopted was to begin with the original equations, in which were employed a considerable number of differentials, and unless they used great caution with those differentials they would be apt to lose a figure, and therefore they require special care. Then there was another matter which rested on him in a great measure, and that was the treatment of symbolical forms upon which the corrections would entirely depend. So that the Society would see there was a great deal of work cut out for him personally. He might add that they were never busier at the Observatory than they were now.

The President said: We must all appreciate the great labour which this treatment of the lunar theory must entail on the Astronomer-Royal, and must admire his courage in undertaking it. In my opinion the method which the Astronomer-Royal has employed of proceeding from the differential equations in which the time is taken as the independent variable is really the best. It is the method which I have myself usually employed in preference to any other. For instance, in the problem of the acceleration of the moon's mean motion, although in my first approximation I took the moon's longitude as the independent variable; yet in my further investigations, the details of which are still unpublished, I found it more advantageous to employ the time as the independent variable. I hope that Sir G. Airy will before very long succeed in finishing this great work to his own satisfaction and that of the astronomical world at large. (Hear, hear.)

Mr. De la Rue then made a statement as to the preparations being made on the Continent for promoting physical astronomy. He said that at Paris a large reflecting telescope, only half-an-inch less than that at Melbourne, was completed. It was mounted in a house which wheeled away, a plan which M. Le Verrier considered would present advantages with respect to variations of temperature. Besides this large instrument M. Le Verrier intended to take up photographic observations with an instrument of large aperture. He was much struck with what was being done in Vienna. The old observatory was in the middle of the city, but Dr. Littrow had succeeded in getting the sanction of the Government to found an observatory really worthy of the Empire. The new observatory was to be outside the city, standing on 15 or 17 acres of ground; it would be 300 feet long and 240 wide. The central dome would be 42 feet in diameter, this was to hold a large reflector of 26 or 27 inches aperture, which Mr. Grubb was making. Besides this there would be three other domes. In one was to be placed an instrument nearly completed by Mr. Alvan Clarke, an equatorial

refractor of 12 inches in diameter, to be devoted mainly to observations of the positions of the minor planets and comets; then there was to be a transit-circle with a telescope of 8-inches in diameter and a prime vertical instrument; and besides this in one of the domes was to be placed a reflector specially devoted to photography, and altogether steps were being taken to promote physical astronomical observations which he was afraid would leave England far behind, unless, with the example Sir G. Airy had shown at Greenwich, the Government was induced to follow it up by rendering help. He thought it right to place on record what he had seen in order to stimulate our Government to do something in the same direction, for it would be hard for England to be left in the rear.

The Astronomer-Royal said the Society must be much obliged to Mr. De la Rue for his statement. It was of the utmost importance to know what was going on in foreign countries. In regard to the last expression of Mr. De la Rue, he imagined it necessary that in the progress of all science they must begin with private enterprise, but when those private efforts had been carried to the extent to which private persons were enabled to carry them, then it became the duty of the State, so far as society would consent, to take it up. (Hear, hear.) It was exactly on this principle that he urged the propriety of the adoption of spectroscopy at the Royal Observatory, that subject having been brought to a successful issue in the hands of Mr. Huggins.

Professor Pritchard was then called upon to read a paper *On the Physical Observatory at Oxford.* He said that he had intended to give the Society an account of what they were doing, but after what he had heard of the magnificent preparations that were being made at the expense of the Austrian Government he felt that the efforts that were being made by his little University were of far too insignificant a character to be mentioned. The Professor then sat down, but on being pressed by the President and the Society, he said that it must not be supposed that his University, which was comparatively poor, could compete with the resources of an Empire like that of Austria. The Professor then came to the table, and said that two years ago it was decided by the University of Oxford to build and maintain an observatory for researches connected with astronomical physics, and for the promotion of the various branches of practical and physical astronomy, especially amongst the members of the University. The building was now complete in all its details, and with one exception no great alteration had been made in the original plans as given in the *Monthly Notices* of December, 1873; that exception was in regard to the arrangement

of the shutters of the revolving domes, of which there were two, one at either end of the building. With the assistance of Mr. Charles Barry the shape of the domes had been reconciled to the requirements of æsthetical architecture, and the shutters had been divided into three parts to slide up and down. This plan had been executed with perfect success. (A large photograph of the building was shown to the meeting.) Mr. Grubb's equatorial reflector of 12¼-inches proved by experience to be an admirably constructed instrument. It was about 176 inches in focal length. The mounting had excited their admiration and gratitude. The contrivances for illuminating the divisions of the declination-circle of 30 inches in diameter and the field of view were ingenious and successful; the clamping of the instrument was effected by an ingenious arrangement of internal and receiving V pieces; the driving clock was as good as any existing anywhere, but was not absolutely faultless. The contrivance for moving the telescope over small arcs was perfectly satisfactory. There were two subsidiary telescopes of 4-inches and 2½-inches attached to the tube, but these were not mere finders, the finders being a pair of rifle sights applied to the 4-inch telescope. There were three micrometers and two double image micrometers, one of the many generous gifts of Mr. De la Rue. (Hear, hear.) The instrument was also furnished with a star spectroscope, by Grubb and Browning, the gift of Mr. De la Rue, and a sun spectroscope admitting of a dispersion of 4, 8 or 12 prisms. There was an efficient observing chair with steps and cushions, and an arrangement for two observers to observe the same object simultaneously with two telescopes. These occupied the large western dome. The eastern (or De la Rue) dome contained Mr. De la Rue's gifts, and they hoped it was destined to effect some work worthy of the reputation of the University. The annex between the two domes was divided into two parts, one containing one of Mr. De la Rue's large reflectors, a transit instrument, and three smaller instruments intended for educational purposes among the members of the University. He was glad to say that there were three tutors of colleges who came in at half-past seven and remained till nine filling up astronomical forms of what they had seen. He hoped that their example might penetrate into the intellectual vitals of the place. (Laughter.) Below the domes were rooms for computing, the director's private room, a photographic room, with a dark chamber, and a lofty basement was below all; in one of which was Mr. De la Rue's polishing machinery for mirrors. Although the observatory had been only completed a few days they already had a considerable list of observations of six of the satellites of Saturn. He must express

his admiration, in conclusion, of the admirable manner in which Mr. Grubb had much more than fulfilled his contract with the University. It was not necessary to go to Munich and other gigantic establishments, for colossal telescopes were at this moment being made in the workshops of Dublin, intended to promote astronomical research in some of the chief cities of the Continent, including Vienna and Potsdam. At the latter place they were going to have nearly the fellow instrument to that at Oxford. He congratulated the University on their munificence in this matter, and also Mr. De la Rue on the auspicious results of an arrangement to which his own generosity gave the first and most important impulse.

The President expressed the thanks of the Society to Professor Pritchard for the paper.

The Astronomer-Royal said that in respect to the best form of dome, he had a letter from Dr. Winnecke stating that for the observatory at Strasburg he was determined to follow the form of drum-dome adopted at Greenwich. From his own experience the Astronomer-Royal said that this was no doubt the best form, and in regard to beauty from an architectural point of view, he thought that "handsome is that handsome does." (Laughter.) In regard to shutters, they had at Greenwich an instance of such shutters as had been described at Oxford, and he disliked them exceedingly.*

Lord Lindsay said his experience went in favour of the drum hemispherical dome He had taken drum-domes to Mauritius, and on another occasion he thought he should take them drums.

Lord Lindsay was then called upon to read a paper on the state of the reductions of his observations of the transit of Venus. It appeared that the time observations and the corrections of chronometers and telegraphic signals for longitude were com-

* [Note by Professor Pritchard :—I have added a note to the remarks made by the Astronomer-Royal on the question of revolving roofs, which he has entirely mistaken. I think my note may be read with some interest, and will compensate for the omission of my other too pungent remarks. The Astronomer-Royal is mistaken in supposing the shutters in the Sheepshanks' dome, at Greenwich, resemble those at Oxford: the principles on which they are constructed are generically different. The gigantic revolving roof of 42 feet diameter, now in course of construction by Mr. Grubb, in Vienna, is *not* a *drum;* but some regard has been paid to appearance. The authorities of Oxford would not readily have permitted either a revolving Stilton cheese, or a mounted batter pudding to have defaced the beautiful park which they have so munificently purchased and devoted to the enjoyment of the public. It was this consideration mainly which induced the Professor of Astronomy and Mr. C. Barry to attempt some reconciliation of the claims of astronomy with those of architecture, and they believe they have succeeded.—C. P.]

pleted, but that the reductions of the actual observations of the transit and the measurements of the photographs were only just commenced.

Mr. Bidder explained a simple and inexpensive observing chair which he had devised. It was exhibited to the meeting, and consisted of a board with two legs pivoted to its sides and projecting at the back, their position was regulated by a cord wound on a roller behind the centre of the board, so that any inclination for the observer could be obtained. At the bottom of the board were moveable steps, so that when the board was nearly vertical the observer could mount as high as he pleased. In the reclining position his head rested on a cushion.

The Astronomer-Royal suggested that if Mr. Bidder had had the luxury of something with which to lift his head up by a screw motion gradually he would never have abandoned it—the object of this was to relieve the muscles of the neck.

Lord Lindsay said he used an air cushion half full of air, and when necessary he blew himself up till his head was the right height.

The Astronomer-Royal said that he had seen an air cushion used in Paris, for the backing of a speculum. The definition of the instrument depended upon blowing the air into a cushion behind the speculum. By this means pressure could be produced to a great degree of nicety. He had never seen such definition produced before.

Mr. Hilger read a paper explaining an elaborate spectroscope which he exhibited.

Mr. Dunkin read a note *On Six Minor Planets*, which had been discovered since Sept. 21. They are numbered from 149 to 154. 149 was discovered at Toulouse, Sept 21; 150 in America, Oct. 19; 151, Nov. 1, at Paris; 152, at Paris, Nov. 2; 153 within an hour on the same night; and 154 was discovered on Nov. 4, also at Paris. Mr. Dunkin remarked that the number of planets was now so great that it was impossible for calculations to keep pace with the required ephemerides. If those who made observations would select a few it would save a great waste of time. At the Observatory every small planet was observed where there was an ephemeris, yet in three months the ephemerides were so bad that out of 25 observations, three only were really observations of planets. It was time, therefore, that a selection was made, and the others dropped altogether.

The following papers were taken as read:—

Note on the Position of the Equinoxes, by Professor Newcomb.

Remarks on Drawings of Jupiter, made by Miss Hirst, at Auckland, New Zealand, by Mr. S. J. Lambert.

Phenomena of Jupiter's Satellites observed at Mr. E. Crossley's Observatory, Bermerside, Halifax, by Mr. E. Crossley and Mr. J. Gledhill.

Occultation of Mars, observed at Windsor, New South Wales, by Mr. J. Tebbutt.

Note on a successful attempt to support a Mercury Trough by a compact and easily removable arrangement, by Colonel Tennant.

Note on Mr. Pritchard's Ephemeris of Circumpolar Stars, by Colonel Tennant.

Drawings of Mars and Jupiter, made with the 26-inch Equatorial of the United States' Naval Observatory, by Professor Holden.

Catalogue of Points on the Moon's Surface whose position has been recently determined by Micrometrical Measures, by Mr. E. Neison.

On the Error of the Tabular Place of Venus during the Transit of December 8, 1874, *by* Colonel Tennant.

Observations of the Zodiacal Light at Cadiz, by Senor Arcimis.

Partial Eclipse of the Sun, 1875, *September* 28—29, *observed at Forest Lodge, Maresfield, by* Captain W. Noble.

Occultations of ζ *Arietis and* χ *Aquarii by the Moon, observed at Forest Lodge, Maresfield, by* Captain W. Noble.

On the Aspect of the Zodiacal Light opposite the Sun, by Mr. S. W. Backhouse.

Observations of the Solar Eclipse of 1875, *September* 28—29, *made at the Royal Observatory, Greenwich, by* The Astronomer-Royal.

Chart of the Apparent Path of Mars, 1877, *by* The Astronomer-Royal.

Notes to accompany drawings of Coggia's Comet, by Mrs. Newall.

Spectroscopic Observations, made at the Royal Observatory, Greenwich, by The Astronomer-Royal.

Notes on an Old Picture of the Sun, by Signor Capello.

The meeting adjourned at ten o'clock.

D'ARREST ON THE DISCOVERY OF NEW REMARKABLE STELLAR SPECTRA OF SECCHI'S 3rd and 4th TYPES.

No. III.

(From *Astronomische Nachrichten* No. 2,032.)
(Continued from *Astronomische Nachrichten* No. 2,009 and 2,016.)

A continuation of the review of the stars of the northern sky, since the second communication upon remarkable absorption spectra was published in November, 1874, has led to the know-

ledge of the following additional objects. As formerly, this increase in number is confined almost exclusively to stellar spectra bearing a distinct character of the 3rd type. Conspicuous and prominent objects of this kind are therefore, as we now ascertain, scattered tolerably plentifully, and in all directions over the sky, while there is also preserved, speaking generally, a striking similarity amongst them. The position and grouping of the dark absorption bands that form the divisions are in accordance throughout, as *Secchi* quite correctly conjectured from the uniform appearance which they presented, and as *Dr. Vogel* first established accurately in 1872 in the case of four brilliant stars. Even the different intensity of the stripes, as a rule strongest towards the red end, but frequently equally pronounced throughout, can modify but little the extremly characteristic appearance. There is thus maintained in fact a remarkable uniformity throughout all these splendid spectra.

Nevertheless, objects that are as signal as is the majority of those published in these series are in themselves rare when compared with the prodigious number of indifferent ones. On the whole I have hitherto met with about eighty spectra of the 3rd kind out of about 11,000 stars, the quality of whose light I have tested. And as while doing this a knowledge of only five new spectra of the 4th type was obtained, it is evident that with our present means there is not anything like a hope of meeting a *single one* such star in passing a thousand in review. On the other hand with spectra of the 3rd type it may be hoped that *one* may be met with among every 140 stars. The experience thus gained holds good up to the 7, 8 magnitude inclusive.

In another respect, as far as we can here speak of results, the only certain inference to be drawn appears to me to be this, namely, that no general conclusion can be established without at once numerous exceptions and contradictory evidence being adduced. In a careful study of the heavens it will be found that the same condition holds good that obtains in all cosmological examinations, those not excepted that have been started in recent times or have been brought forward anew. Simple principles assuredly do not suffice for, neither do they adapt themselves to, the numerous unknown factors that interlock in the complicated structure of the heavens.

(1855·0).

1. B. D. — 1. 2471; 61 *Leon;* B.A.C. 3775.

A. R. 10h. 54m. 26·6s. Decl. — 1° 42′·1. Mag. 5·2.

Columnar spectrum of 3rd type. Division of the columns especially sharp and dark in the orange and red. Colour of the star not striking.

2. B. D. — 0·890; LL. 9821; W. V. 148.
R. A. 5h. 7m. 13·1s. Decl. — 0° 43'·9. Mag. 7.
Star 8·8 mag., faint yet distinctly pronounced colonnade spectrum of the 3rd type, easily recognised. No remarkable colour observed.

3. B. D. + 2. 2145; LL. 17988; W. viii. 1508.
R. A. 8h. 59m. 31·5s. Decl. + 2° 2'·6. Mag. 6·8.
Star 7 mag., almost colourless, but its spectrum almost discontinuous, one of the finest specimens of the pure 3rd type.

4. B. D. + 2. 2409; 75 *Leon;* B.A.C. 3850.
R. A. 11h. 9m. 49·3s. Decl. + 2° 48'·7. Mag. 5·5.
Star 5·6 mag., colourless. Spectrum 3rd type, with intensely dark stripes readily made out through all the colours. The column seen again subsequently.

5. B. D. + 5. 1759; W. vii. 1093.
R. A. 7h. 35m. 40·6s. Decl. + 5° 17'·0. Mag. 7·1.
Star 8 mag., light red, with very evident zonal spectrum; owing to the faintness of the star to be made out, however, only when the atmosphere is good.*

6. B. D. + 7. 2479; 3 *ν. Virgin;* B.A.C. 3982.
R. A. 11h. 38m. 25·2s. Decl. 7° 20'·2. Mag. 4·3.
Star 5 mag., colourless (at times yellowish). Spectrum with splendid zones; the 3rd type is to be recognised without difficulty, even during moonlight.

7. B. D. + 13. 1912; 27 *Cancri;* B.A.C. 2826; LL. 16558.
R. A. 8h. 18m. 43·6s. Decl. + 13° 7'·3. Mag. 5·8.
Fine example of the 3rd type. Bands broad and dark even in the green and through the zone of the blue. Star 6·7 mag., without striking colour, at most pale yellowish.

8. B. D. + 14. 1729; LL. 14961; W. vii 1041.
B. A. 7h. 33m. 54·4s. Decl. + 14° 32'·5. Mag. 6.
Star 7 mag., yellowish. Spectrum is a pretty specimen of 3rd type. The interstices are one one side well defined, otherwise broad and dark, but especially in the red.

9. B. D. + 14. 2136; *ψ Leon;* B.A.C. 3321; R. 2923.
R. A. 9h. 35m. 49·6s. Decl. + 14° 40'·5. Mag. 6·0.
Very distinct thoroughly normal zonal spectrum of 3rd type. The dark bands well seen even up beyond the green. Found again several times, the star, therefore, in fact has a yellowish look.

10. B. D. + 14. 2228; 37 *Leon;* B.A.C. 3510; R. 3117.
R. A. 10h. 8m. 53·7s. Decl. + 14° 27'·9. Mag. 5·7.
Star 6 mag., with very striking columnar spectrum, especially distinct towards the red end.

* N.B.—In *Astronomische Nachrichten* the B. D. is incorrectly printed +25. 1759.

11. B. D. + 15. 2758; LL. 26918; R. 4813.
R. A. 14h. 39m. 16·9s. Decl. 15° 44'·9. Mag. 5·5.
Star 6 mag., light yellow. Splendid columns in normal form of type 3. The bands broad, very dark, and fading away on one side over the entire prismatic image.

12. B. D. + 16. 1417; B.A.C. 2362; 51 *Gemin.*
R. A. 7h. 5m. 4·4s. Decl. + 16° 24'·6. Mag. 5·5.
Star 5·6 light yellow. Extraordinarily beautiful spe trum of the 3rd type. One of the most interesting examples ofche kindt with bands so broad that seldom can anything similar tbe brouhg forward.

13. B. D. + 18. 2682; 36 *Comæ;* B.A.C. 4351; R. 4202.
R. A. 12h. 51m. 45·9s. Decl. + 18° 11'·5. Mag. 4·8.
Star 5 mag., light orange, with good columnar spectrum, though less excellent than 40 *Comæ.* Examined occasionally again.

14. B. D. + 23. 1887; 9 μ^1 *Cancri;* B.A.C. 2700.
R. A. 7h. 57m. 42·9s. Decl. + 23° 2'·9. Mag. 6·0.
Star 7 mag., without colour. Spectrum, owing to the faintness of the star, less splendid it is true than that of 51 *Geminorum,* yet the similarity of its nature recognizable without difficulty.

15. B. D. + 23. 2538; 40 *Comæ;* B.A.C. 4388.
R. A. 12h. 59m. 20·6s. Decl. + 23° 24'·4. Mag. 5·8.
Star 6 mag., colourless. Type 3. The broad and very dark absorption bands are in the normal positions throughout the entire spectrum; almost as excellent as 51 *Geminorum.* Observed again several times. Star now and then yellowish.

16. B. D. + 26. 1117; LL. 11684; W. vi. i.
R. A. 6h. 1m. 52·1s. Decl. + 26° 2'·9. Mag. 7·4.
Star 8 mag., dark red, shows a superb spectum of the 4th type, by far brighter and more distinct than other stars of the same magnitude. Broad clear stripes between wide dark gaps, by which this remarkable spectrum is entirely broken up. The garnet colour of this star was long known, not so its spectrum.

17. B. D. + 26. 2563; LL. 26342.
R. A. 14h. 17m. 40·2s. Decl. 26° 22'·6. Mag. 8·0.
Star 8·2 mag., red like coal at a dull red heat. This difficult spectrum is evidently of the 3rd type, and not, as might almost be expected, of the 4th. *Dr. Vogel* has already made out dark bands in it (*Bothkamp* II., p. 28.). Star, Schj. 169.

18. B. D. + 27. 2413; 34 *Bootis;* B.A.C. 4864.
R. A. 14h. 37m. 2·7s. Decl. + 27° 8'·9. Mag. 5·8.
Star 6 mag., light reddish-yellow. Columns in the spectrum broad and distinct through all the colours; the bands are pecu-

liarly dark however in the red. This is the star the variability of which has been recently established by *Dr. J. Schmidt, Astronomische Nachrichten*, Vol. 80. p. 231.

19. B. D. + 31. 1946; LL. 18044, 45; W. ix. 3.
R. A. 9h. 1m. 52·2s. Decl. 31° 33'·8. Mag. 6·5.

Star 7 mag. (certainly not 5·6 LL.), light reddish, frequently yellowish. Admirable spectrum of the 3rd type, almost as perfectly developed as in the case of *α Herculis*, *β Persei* and similar stars. A slight variability of this star may be therefore held to be very probable.

20. B. D. + 37. 2162; B.A.C. 3811; W. x. 1236-40.
R. A. 11h. 1m. 20·0s. Decl. +37° 6'·5. Mag. 5·9.

Star 6·7 mag. albasubflava. Sharply pronounced spectrum of the 3rd type, normal; columns standing sharply out through all the colours.

21. B. D. + 37. 2230; LL. 22450; W. xi. 925.
R. A. 11h. 47m. 43·9s. Decl. + 37° 35'·1. Mag. 6·5.

Star 7 mag., light yellow. With separated columns through the whole spectrum of the 3rd order.

22. B. D. + 37. 2404; B.A.C. 4479; Radcl. 3007.
R. A. 13h. 17m. 19·6s. Decl. +37° 47'·3. Mag. 6·0.

Star 6 mag., light golden yellow, roseoaurea. Spectrum is a fine example of the pure 3rd type. Bands through all the coloured zones. Frequently examined again.

23. B. D. +42. 1239; W. v. 197; Gr. 953; Radcl. 1441.
R. A. 5h. 7m. 55·4s. Decl. +42° 37'·9. Mag. 6·0.

Star 7 mag., hardly perceptibly yellow. Spectrum with distinct columns between dark broad bands throughout. 3rd type evident.

24. B. D. + 44. 2325; Gr. 2078; Radcl. 3140.
R. A. 14h. 2m. 7·1s. Decl. +44° 32'·4. Mag. 5·3.

Star 5·6 mag., yellowish. Splendid spectrum of 3rd type. Is one of the finest among the strongly pronounced absorption spectra of the northern hemisphere.

25. B. D. + 47. 2053; Arg. Oe. 13583.
R. A. 13h. 16m. 52·3s. Decl. +47° 44'·8. Mag. 7·0.

Star 7 mag., not to be distinguished by colour from the neighbouring stars; its spectrum is discontinuous. What characterises it to be of 3rd type is very distinct.

26. B. D. + 49. 2130; 3 *Can. venat*; B.A.C. 4148.
R. A. 12h. 12m. 40·1s. Decl. +49° 47'·0· Mag. 5·7.

Star 6 mag., yellowish. Perfect spectrum of the 3rd type. Bands broadest in the red, narrower up towards the violet end.

Supplement—Southern Stars.

1. LL. 13627. $\delta = -5°$.
R. A. 6h. 54m.4 9·5s. Decl. —3° 32'·9.

Star 6·7 mag., columnar spectrum; good division, but requiring a still atmosphere.

2. 47 *Erid*; B.A.C. 1419. $\delta = -8°$.
R. A. 4h. 27m. 12·9s. Decl. —8° 32′·3.

Star 6 mag. strikingly red, with admirable spectrum of type 3. Bands peculiarly black in the red. Observation confirmed repeatedly.

3. LL. 9785; W. v. 78. $\delta = -12°$.
R. A. 5h. 4m. 36·6s. Decl. —12° 2′·0.

Star 6·7 yellowish. Splendid specimen of type 3, with the separation of all the typical columns shown with nearly equal precision.

4. 54 *Erid.*; B.A.C. 1451; LL. 8860, 61 $\delta = -20°$.
R. A. 4h. 34m. 6·1s. Decl. —19° 57′·2.

Star 5 mag., yellowish. Banded spectrum of type 3, with very dark intervals to be made out perfectly.

I avail myself of this occasion to subjoin the following four notes bearing upon rare and difficult points, determined with respect to matters connected herewith.

1. During the winter of 1874-75, I have succeeded several times in breaking up perfectly and evidently into groups of distinctly separate lines the dark absorption bands here treated of in the case of bright stars of the 3rd type. These lines increase in each group successively in depth, sharpness, and darkness towards the side of the violet, and thus produce, in ordinary circumstances, and with a low dispersion, the impression of bands sharply bounded on the one side but washy on the other. There is not, it is true, in the northern hemisphere any star of the 4th type bright enough (not above the 6th magnitude) to admit of the same experiment being instituted therewith, but from analogy the inference will in this case not admit of doubt. It may be assumed that in this class, too, the bands consist of separate lines which increase successively in intensity towards the contrary side.

2. At the time of the last maximum of R *Leporis*, in January, 1875, when the star was of the 7·8 magnitude, I found it had a very splendid spectrum of the 4th type. It showed the usual bright bands of this class, the spectrum is not, however, visible in every year, and when so always for a short time only. *Dr. Vogel's* statement made in 1873 (*Astronomische Nachrichten*, No. 2,000 p. 118), in variance with the earlier statement of *Secchi*, is hereby confirmed.

The quality of the light of a few stars having considerable proper motion, has been examined without anything having been manifested, indicating "low brilliancy" as a consequence of strong absorption. Mention has already been made of 61 *Cygni*,

in *Astronomische Nachrichten*, No. 2,016; the spectrum of 1830, Groombridge, is quite indifferent, uniform, continuous.

4. On only one occasion, in December, 1874, I came across a star of the 6th magnitude with extremely strongly pronounced bands, the system of which appeared to assign it to a class apart, differing both from the 3rd and from the 4th type. Such a form as that does not exist among the fixed stars; it soon proved that I had picked up Uranus spectroscopically. I have indeed twice discovered Uranus spectroscopically, by means of the small analyser with a low dispersion that *Dr. Vogel* had made for me, and which I use by preference in my sweeps combined with the great refractor. I recognise therein a proof of the excellence of the apparatus, and also of the somewhat laborious review with which I am busied being carried out in a thorough manner.

At another time I shall bring forward in a connected form other communications derived from observations made at this place, relating in the main to the more accurate knowledge of the red stars we are acquainted with.

Copenhagen: March, 1875. D'ARREST.

In the 3rd series, as in the 1st and 2nd, the magnitudes of the stars as given by D'Arrest, and stated in the translations, do not always agree, as shown in the following table.

	D'Arrest.	In translation.
1	?	5·2
2	8·8	7
3	7	6·8
4	5·6	5·5
5	8	7·1
6	5	4·3
7	6·7	5·8
8	7	6
9	?	6
10	6	5·7
11	6	5·5
12	5·6	5·5
13	5	4·8
14	7	6
15	6	5·8
16	8	7·4
17	8·2	8
18	6	5·8
19	7 "certainly not 5·6 LL."	6·5
20	6·7	5·9
21	7	6·5

22	...	7	...	6
23	...	7	...	6
24	...	5·6	...	5·3
25	...	7	...	7
26	...	6	...	5·7
		Supplement.		
1	...	6·7	...	?
2	...	6	...	?
3	...	6·7	...	?
4	...	5	...	?

P.S.—The magnitudes stated as being given "in the translation" are those printed on the same line as the R. A and the declination. The magnitudes as given by D'Arrest are those in the text.—A. B.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

FLATTENINGS ON THE MOON'S WESTERN LIMB.

Sir,—Mr. Marth having called the attention of your readers to the Flattenings, first noticed by the Rev. H. C. Key, the following observations, extracted from my journal under date of November 3, 4 and 5, 1864, may be interesting. Instrument R. A. S. Sheepshanks' telescope, No. 5, power 100 on o. g. of 2·75 inches aperture.

Nov. 3. 6. 0. At first the atmosphere was in such a state of disturbance that the true outline of the limb could not be easily made out; I was however, able afterwards to ascertain that instead of the limb being circular in the neighbourhood of the equator, it was sufficiently flattened for a spider line to lie along it; the south end nearly coincided with a line from Langrenus to Guttemberg, the north being nearly identical with the south border of the Mare Crisium. At 5.15 the terminator was seen grazing the eastern edge of Hercules.

Nov. 4. 5. 0. Terminator through the west part of the Mare Serenitatis apparently coincident with Schröter's serpentine ridge, also just east of Theophilus. *Equatorial Flattening.*—This is quite perceptible to-night. The mounting of this glass is too unsteady to get any good determination. The south end of the flattening nearly coincides with a line passing just south of Langrenus and Guttemberg, the north end considerably south of the Mare Crisium. The flattening lies pretty evenly with the spider line. *Mem.*—Determine the two ends by alignment and take angle of position and also length.

Nov. 5. 6. 0. Terminator through the eastern part of the Mare Serenitatis, definition good. *Rev. H. C. Key's Flattenings.*—The positions of these flattenings are certainly variable; last night the flattening observed was certainly south to a great extent of the Mare Crisium, to-night there is a flattening, not to so great an extent, nearly parallel with the length of the Mare Crisium, the outline is very slightly curved

outwards or convex. At 6.30 the record proceeds "This flattening, which is not very decided, extends from Hevel's *Paludes Amaræ** to a point nearly opposite to Schröter's Alhazen. The flattenings seen on the 4th terminated with a short protuberance, and that seen on the 5th in one also, but that seen on the 4th was the most decided. On the evening of Friday, November 12, 1875, I obtained, with the same instrument, a view of the depression seen on November 3 and 4, 1864, the record of which is given above; the following is the record of the observation in my journal.

"G. M. T., 6 to 7 p.m. *Flattenings on the Moon's Limb.* The principal flattening was opposite the Mare Fœcunditatis. Sky hazy, but at times definition was sufficiently good to allow a spider line to be laid evenly along this depression. The following alignments were taken: from the south end a line passed through the south part of Langrenus to the south edges of Hind and Halley: from the north end, through the north end of Apollonius and through the bright spot Aridæus: these alignments are somewhat rough, but sufficient to indicate that the flattening extends from about 5° N. latitude to about 9° S. latitude."

Immediately adjoining this depression on the south, probably not more than half the length, was another, the two being distinctly separated by a prominence, and the southern depression terminating with a bright spot, query crater, which I failed to identify. A line from this spot passed north of Vendelinus, but it was too hazy to identify any other object on it.

The agreement of the observations in 1864 and 1875 is sufficiently close to identify the equatorial depression for which I propose the name K E Y. Its extent in latitude from the south of Langrenus to the south border of the Mare Crisium, *i.e.*, it lies parallel with these points, may be regarded as settled. If Mr. Marth will kindly oblige your readers with the conditions of libration when it is visible, and the intervals between its successive apparitions, it is not unlikely that continued observations of it, and the other depressions that have been noticed, may make us better acquainted with the formations in the western librated region. I am, sir, your obedient servant,

W. R. BIRT.

THE MOON.

On Friday last, November 12th, I examined the moon's limb, and found Key's depressions too obvious to be overlooked by the most inattentive observer. The telescope used was a Newtonian, with an unsilvered glass speculum of 10¼ inches aperture, and power 150 ±.

The depressions were even more strikingly seen in October last, with a slightly-silvered 12¼-inch speculum, and power 150 ±.

Hereford: GEORGE H. WITH.

November 13th, 1875.

Attention having been directed by Mr. Marth in the October number of the *Register*, to Mr. Key's depressions in the limb of the moon, I tried on the 11th November, at 9·25 G. M. T., whether I could see them.

The flattenings of the limb were at once evident, and on laying the thick bars of the micrometer parallel to them I found their position, inverted, to be respectively 153° and 146°.

The longest of the two flats was at 153°, and for something more than 3 minutes of arc, corresponding to 12° of lunar latitude, the limb did not deviate from the straight edge of the bar.

* See *Webb's Celestial Objects*, Third Edition, p. 85.

At the time of observation the extreme summits of the highest mountains at the far side of these depressions were still illuminated by the rays of the setting sun.

Telescope used was the 7½ Alvan-Clarke. Power 100 with, and without a neutral tinted shade. Bad weather prevented further observation.

Sherrington, Bray: November, 1875. WENTWORTH ERCK.

Sir,—I was glad to see that Mr. Marth had been so good as to ascertain and publish for the benefit of your readers, the dates at which the moon's libration would be nearly the same as on the occasion when I observed certain very surprising depressions on her surface.

On the 12th instant, in order to see with how small an aperture they might be visible, I examined the limb with an achromatic of 1⅝-inch aperture, and with those small means they were unmistakeable. The limb in these places, each of them extending for several hundred miles, was as straight as a micrometer web, and if similar straight surfaces had extended round the whole moon, her form would have been a very decided dodecahedron, and not a circle. I am, sir, yours faithfully,

HENRY COOPER KEY.

EPHEMERIS OF THE SATELLITES OF SATURN.

The rectangular co-ordinates of the three inner satellites and the apparent distances of Titan and Iapetus, are expressed in semi-diameters of the planet's equator.—" pos."=angle of position.

$+x$ East of minor axis of ring. $+y$ North of major axis of ring.
$-x$ West " " " $-y$ South " " "

At 20h. Greenwich Sidereal Time.

1875.	Tethys.		Dione.		Rhea.		Titan.		Iapetus.	
Dec.	x	y	x	y	x	y	pos.	dist.	pos.	dist.
1	−5·0	0·0	−5·7	+0·7	+8·4	−0·7	95·1	20·9	94·1	27·6
2	+4·9	−0·2	+5·9	+0·6	−1·4	−2·1	100·3	20·3	95·0	23·4
3	−4·7	+0·4	−2·1	−1·4	−8·9	0·0	106·6	17·1	96·2	19·1
4	+4·4	−0·6	−3·1	+1·3	−1·8	+2·1	117·6	11·7	98·1	14·8
5	−3·9	+0.7	+6·3	−0·3	+8·3	+0·8	150·1	6·0	101·6	10·4
6	+3·3	−0·9	−5·1	−0·9	+4·9	−1·8	228·4	6·4	110·	6·0
7	−2·6	+1·0	+0·4	+1·5	−6·5	−1·4	257·1	12·3	154·	2·3
8	+1·8	−1·1	+4·5	−1·1	−7·3	+1·2	267·4	17·3	240·	4·1
9	−1·0	+1·1	−6.4	−0.1	+3·8	+1·9	273·7	20·1	256·1	8·4

Approximate times of the conjunctions of the satellites with the centre of the planet, or of their passing in the direction of the minor axis of the ring.

Gr. Sid. Time.	h.		y
Dec. 1	3·8	Encel.	−1·0
	7·5	Dione	+1·5
	7·6	Tethys	+1·2
2	17·2	Rhea	−2·1
	20·3	Encel.	+1·0
	6·3	Tethys	−1·2
	12 8	Encel.	−1·0
	16·4	Dione	−1·5
3	5·1	Tethys	+1·2
	5·3	Encel.	+0·9
4	21.8	Encel.	−0·9
	23·6	Rhea	+2·1
	1·4	Dione	+1·5
	3·8	Tethys	−1·2
	14·3	Encel.	+0·9
5	2·5	Tethys	+1·2
	6·8	Encel.	−0·9
	7.0	Titan	−4·8
	10·3	Dione	−1·5

Gr. Sid. Time.	h.		y
Dec. 6	23·3	Encel.	+0·9
	1·2	Tethys	−1·2
	6·0	Rhea	−2·1
	15·8	Encel.	−0·9
7	19·3	Dione	+1·5
	0·0	Tethys	+1·2
?	3	Iapetus	−2·1
	8·3	Encel.	+0·9
8	22·7	Tethys	−1·2
	0·8	Encel.	−0·9
	4·2	Dione	−1.5
?	6	Shadow of Iapetus on the disc of Saturn.	
	12·4	Rhea	+2·1
9	17·2	Encel.	+0·9
	21·4	Tethys	+1.2
	9·7	Encel.	−0·9
	13·2	Dione	+1·5

A. MARTH.

ASTRONOMICAL OCCURRENCES FOR DECEMBER, 1875.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Wed	1		Sidereal Time at Mean Noon, 16h. 39m. 44·78s.	3rd Tr. E.	18 6	Mars. 5 17·5
Thur	2		Sun's Meridian Passage 10m. 28·99s. before Mean Noon			Moon. — 3 32·5
Fri	3	4 43 17	Near approach of ϕ Capricorni (5½) Conjunction of Moon and Saturn, 2° 25′ N.	2nd Tr. I. 2nd Sh. E.	18 2 19 37	4 20·2
Sat	4	9	Conjunction of Moon and Mars 1° 58′ N.	1st Ec. D.	18 42 31	5 5·9
Sun	5	13 56	☽ Moon's First Quarter	1st Sh. E. 1st Tr. E.	18 10 18 42	5 50·3
Mon	6	10 45 11 44	Occultation of 20 Piscium (6) Reappearance of ditto			6 34·3
Tues	7	3 59 4 44	Occultation of 44 Piscium (6) Reappearance of ditto Saturn's Ring: Major axis=36″·85 Minor axis=8″·61			7 19·2
Wed	8			3rd Sh. I.	18 11	8 6·4
Thur	9	6 4 7 7	Occultation of 19 Arietis (6) Reappearance of ditto			8 57·7
Fri	10	7 29 8 35 7	Occultation of ζ Arietis (4½) Reappearance of ditto Conjunction of Mars and π Aquarii (1·5m. E.) Conjunction of Mars and σ Aquarii 0° 9′ S.	2nd Sh. I.	19 42	9 54·4
Sat	11	9 8 10 10	Occultation of χ^1 Tauri (5½) Reappearance of ditto			10 56·9
Sun	12	7 45 11 3 12 1 18 18 19 7	○ Full Moon Occultation of B.A.C. 1746 (6½) Reappearance of ditto Occultation of 136 Tauri (5) Reappearance of ditto	1st Sh. I. 2nd Oc. R. 1st Tr. I.	17 51 18 22 18 29	12 4·1
Mon	13			1st Oc. R.	17 53	α Arietis 8 31·7
Tues	14	7 28 8 0 15 30	Occultation of c Geminorum (6) Reappearance of ditto Near approach of ω^1 Cancri (6½)			8 27·8

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. α Arietis
Wed	15		Illuminated portion of disc of Venus=0·939 Illuminated portion of disc of Mars=0·873			8 23·9
Thur	16					8 19·9
Fri	17		Sidereal Time at Mean Noon 17h. 42m. 49·72s.			8 16·1
Sat	18		Sun's Meridian Passage 3m. 17·23s. before Mean Noon			8 12·1
Sun	19	2 55	☾ Moon's Last Quarter	2nd Ec. D. 3rd Oc. R. 1st Sh. I.	17 11 29 17 12 19 45	8 8·2
Mon	20	15 49 16 57 22	Occultation of B.A.C. 4394 (6) Reappearance of ditto Conjunction of Mars and λ Aquarii (5·1m.) W.	1st Ec. D. 1st Oc. R.	16 58 37 19 53	8 4·2
Tues	21			1st Tr. I.	17 11	8 0·3
Wed	22					7 56·4
Thur	23	18	Conjunction of Moon and Jupiter, 4° 54′ N.			7 52·4
Fri	24					7 48·5
Sat	25	21	Superior conjunction of Mercury and Sun			7 44·6
Sun	26	1	Conjunction of Mars and and φ Aquarii (3·1m.) E.	3rd Ec. R. 3rd Oc. D. 2nd Ec. D.	18 2 13 19 33 19 44 38	7 40·6
Mon	27	9 7 4	Conjunction of Moon and Mercury 3° 14′ N. ● New Moon Saturn's Ring: Major axis=35″·88 Minor axis=7″·93	1st Ec. D.	18 52 23	6 36·7
Tues	28			2nd Sh. E. 1st Tr. I. 1st Sh. E. 2nd Tr. E. 1st Tr. E.	16 44 16 57 18 18 18 25 19 19	7 32·7
Wed	29	10	Conjunction of Moon and Venus 2° 52′ N.			7 28·8
Thur	30					7 24·9
Fri	31	4	Conjunction of Moon and Saturn 2° 3′ N.			7 20·9
1876 JAN. Sat	1					7 17·1

THE PLANETS FOR DECEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian Passage.
		h. m. s.	° ′		h. m.
Mercury ...	1st	15 39 12	S. 18 40½	5″·0	22 55·7
	9th	16 30 14	S. 21 59	4″·8	23 15·1
	17th	17 23 52	S. 24 10½	4″·6	23 37·2
	25th	* * *	* * *	*	* *
Venus ...	1st	17 44 14	S. 24 17	10″·4	1 4·3
	9th	18 28 14	S. 24 27	10″·6	1 16·7
	17th	19 12 1	S. 23 49	10″·6	1 28·9
	25th	19 55 3	S. 22 24	11″·0	1 40·4
Mars ...	1st	21 58 6	S. 13 48½	9″·1	5 17·5
	9th	22 19 48	S. 11 36½	8″·6	5 7·7
	17th	12 41 16	S. 9 11½	8″·2	4 57·6
	25th	23 2 32	S. 6 58	8″·0	4 47·4
Saturn ...	1st	21 33 56	S. 15 53	14″·9	4 53·4
	14th	21 37 35	S. 15 34½	14″·6	4 5·9
Uranus ...	27th	9 28 52	S. 15 39	4″·2	15 4·2
Neptune ...	3rd	1 56 41	N. 10 1	...	9 7·6
	19th	1 55 42	N. 9 56	...	8 3·6

Mercury may be observed an hour and a quarter before sunrise at the beginning of the month, the interval rapidly decreasing.

Venus sets about an hour after the sun on the 1st, the interval increasing to two hours by the end of the month.

Mars will be visible for about six hours after sunset throughout the month.

Saturn sets about two hours and a half before midnight, the interval increasing.

DISCOVERY OF FIVE NEW PLANETS.

From *Astronomische Nachrichten*, No. 2,064.

Planet (151), discovered by M. Palisa, 1 November; was observed.

1875, Nov. 1. 13h. 24m. M. T. Pola α 3h. 2m. 16s. $\delta = +18° 20'$.

„ 2. 10h. 37m. 26s. M.T. Berlin 3h. 1m. 23·69s. $+18° 19'·09''$.

Mag. = 9. (*Bulletin International*, No. 310.)

Planet (152), discovered by M. Paul Henry, 2 November.

1875, Nov. 2. 11h. 0m. M.T. Paris α 2h. 38m. 17s. $\delta = +15° 25'$.

(*Bulletin International*, No. 307.)

„ 5. 10h. 20·44m. M.T Leipsig 2h. 35m. 37·44s. $\delta = +15° 24' 16.3''$.

Mag. = 11.

Planet (153), discovered by M. Palisa, 2 November.

1875, Nov. 2. 12h. 12m. 26s. M.T. Pola α 3h. 1m. 29s. $\delta = +17° 34'$.

„ 3. 8h. 56m 22s. „ „ 3h. 1m. 56·89s. $\delta = +17° 31' 20·4''$.

Mag. = 12 to 12·5.

Planet (154), discovered by M. Prosper Henry, 6 November.

Telegraphic despatch to the observatory at Berlin (November 6):—Planet two hours twenty-seven north, sixteen degrees twenty-eight, very slight motion south, twelfth, by Prosper Henry.

Planet (155), discovered by M. Palisa, 8, November. Telegram to the observatory at Berlin:—

November 8. 14h. 12m. Pola 3h. 0m. 12s. $+19° 48'$. Motion—52s.

Mag. = 12.

Kiel, November 9, 1875.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN DECEMBER, 1875.

By W. R. Birt, F.R.A.S., F.M.S.

Zones XXX. to XXXVI. British Association map, 70° to 90° S. latitude, region around the South Pole.

In 50° W. longitude of Zone XXX. the west border of Boguslawsky (398), the east border is in 40° W. longitude. Schomberger (397) is in Zone XXXII. (75° to 80°), its west border being in 35° W. longitude, and its east border in 17° W. longitude. Simpelius (403) is in Zone XXX. west border 18° west longitude, east border 8° W. longitude. There are four large unnamed craters in these Zones XXX. and XXXII. west of the first meridian. Situated on the moon's limb, extending on both sides of the pole, are the Leibnitz mountains (259): see Schröter's *Fragments*, T. IV. and LXIII. and vol. I. § § 79 to 82, pp. 138 to 142. vol. II. § § 923 to 927, pp. 356 to 362; also Webb's *Celestial Objects for Common Telescopes*, third edition, p. 111 where he says "By some unwonted inadvertence B. and M. have interchanged the names of 246, the Dörfel mountains and 259 the Leibnitz mountains." East of the first meridian in Zone XXXVI. we have near the south pole Malapert (258), and in Zone XXXIV. Cabeus (257). Zone XXXII. contains, a little east of the first meridian, a group of three unnamed craters, east of which is B. and M's. Newton (256). Schröter's Newton, an interesting object, is in the opposite hemisphere just south of Plato. Webb's note (third edition, p. 110) on the transference of the name by B. and M. is so much to the point, especially as regards confusion in nomenclature, that we reproduce it. "B. and M. transferred this name from a spot so called by Schröter in the Mare Imbrium, close to Plato, which they thought unworthy of the designation. There was some inducement in this instance, but the precedent should not be followed, as liable to produce confusion." Proceeding eastward from the first meridian the fine formations Moretus (262) and Short (263) are met with. The south part of Moretus and the north part of Short are in Zone XXX.; the south part of Short is in Zone XXXII. (*a*). About 15° east of these walled plains we meet with another pair, Klaproth (255) and Casatus (254) (*b*). The southern part of Klaproth and the whole of Casatus are in Zone XXX. It would appear from B. and M's. map that Casatus is a more recent formation than Klaproth. East of Casatus is an unnamed crater. Beyond these formations there are no prominent objects except the south part of Wilson (253). See list for October, *ante* p. 248. In order to observe the objects abovementioned well the moon should have great north latitude.

(*a*). In Schröter's *Fragments*, T. XLVII. will be found his drawings of Short, Curtius, Moretus, Cysatus and Gruemberger, with an unnamed crater B, encroaching on the west end of Gruemberger, vol. II., §§ 587 to 596 on pp. 53 to 60, contains a description of these craters.

(*b*). A fine drawing of Casatus on the Terminator, October 14, 1788, will be found on T. L. of Schröter's *Fragments*: see the description § 617, vol. II. p. 78. Brewster in his edition of Ferguson's *Astronomy* describes it as a "long cavity with central mountains and three luminous ridges beyond its east margin."

Brewster's Edition of Furguson contains, so far as we are aware, the only list of spots on the moon's surface to which names were given by Schröter; among them is "Le Gentil," described by Brewster as "annular with central eminence." It is situated between Casatus and Bailey and is well figured in T. L. fig. 3 of Schröder's *Fragments*. This drawing should should be compared with the moon, as there is no

appearance of "Le Gentil" on B. and M's. map. As it is near the limb, a particular illumination is necessary to render it visible *as Schröter saw it*, and this may not have occurred during B. and M's. observations, and from this circumstance it is probable they omitted it altogether. The reader will find in Brewster's additions to Ferguson Schröter's measures of the heights of mountains, also of the depths and orifices of craters expressed in English miles and decimals of miles.

Errata.—In list for November, second paragraph, lines 2 to 4, for *Euchemon* read *Euctemon;* also in line 4 for *his* read *this.*

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

Greenwich, Noon. 1875.	Heliographical west. long. of the centre of the sun's disc.		Heliographical lat. of the centre of the sun's disc.	Angle of position of sun's axis.	
	°	°	°	°	
Dec. 1	77·03	+13·19	+0·64	16·09	—·39
2	90·22	·19	0·51	15·70	·40
3	103·41	·20	0.38	15·30	·41
4	116·61	·19	0·26	14·89	·41
5	129·80	13·19	+0·13	14·48	—·41
6	142·99	·19	0·00	14·07	·42
7	156.18	·20	—0·13	13·65	·43
8	169·38	·19	0·26	13·22	·43
9	182·57	·19	0·39	12·79	·43
10	195·76	·19	0·52	12·36	·44
11	208·95	·19	0·64	11·92	·45
12	222·14	13·19	—0·77	11·47	—·45
13	225·33	·19	0·90	11·02	·45
14	248·52	·19	1·02	10·57	·45
15	261·71	·19	1·15	10·12	·46
16	274·90	·19	1·28	9·66	·46
17	288·09	·19	1·40	9·20	·47
18	301·28	·19	1·53	8·73	·47
19	314·47	13·19	—1·66	8·26	—·47
20	327·66	·19	1·78	7·79	·47
21	340·85	·19	1·90	7·32	·48
22	354·04	·18	2·03	6·84	·48
23	7·22	·19	2·15	6·36	·48
24	20·41	·19	2·27	5·88	·48
25	33·60	·19	2·40	5·40	·49
26	46·79	13·19	—2·52	4·91	—·48
27	59·97	·19	2·64	4·43	·49
28	73·16	·18	2·76	3·94	·49
29	86·34	·19	2·88	3·45	·49
30	99·53	·19	2·99	2·96	·49
31	112·72		—3·11	2·47	

Assumed daily rate of rotation 14°·20.

A. M.

Erratum.—November No., page 272, line 2, for *Dawer* read *Dawes.*

We are obliged to omit General Notices through want of space.